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ANNUAL REPORT

OF THE

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

FOR

1949-50

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CONTENTS

	Pages
Summary	i—vii
Chapter I.—Administration	
General	1
Meetings	1
Finance and Accounts	2
Chapter II.—Agricultural Research	
General	3—6
Rice	6—8
Wheat	8
Maize	8—9
Soyabeans	9—10
Pulses	10—13
Millets	13—14
Other Crops	14—15
Fruits	15—19
Fruit Preservation Training Course for Ladies	19
Scheme for the Description of Important Varieties of Fruits Grown in India	19
Scheme for Abstraction of Horticultural Literature	20
Vegetables	20—21
Soil Science	21—22
Agronomy	23
Botany and Cytology	23—24
Entomology and Mycology	24—25
Chapter III.—Fruit Technology	
General	26
Biochemical Investigations	26—28
Microbiological Investigations	28—30
Technical Assistance and Advice	30
Teaching	31
Miscellaneous	31
Chapter IV.—Animal Husbandry Research	
Livestock Breeding	32—36
Dairying	37—39
Animal Nutrition	39—41
Disease Control	41—51
Other Items	51—53
Chapter V.—Delhi Development Scheme	
General	54
Activities	54

CHAPTER VI.—COMBINED AGRICULTURAL AND ANIMAL HUSBANDRY RESEARCH

Village Rehabilitation Scheme, Baroda 56
Soil Science 56
Fodder and Grasses . . . . . 56—57
Regionalization of Agricultural and Animal Husbandry Research . 57—58

CHAPTER VII.—STATISTICAL BRANCH

Advisory Work 59
Training . . . . . 59—60
Research . . . . . 60—62

CHAPTER VIII.—GENERAL

Publications . . . . . 63—64
Library . . . . . 64—66
Appendix 68

SUMMARY

OF THE

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FOR

1949-50

General

The 20th Annual Report of the I.C.A.R. (for the year 1949-50) gives some of the outstanding achievements of the year. In addition to the Council's existing schemes aggregating to 268 (including 126 on the agricultural side, 114 on the animal husbandry side and 28 under the miscellaneous head), 47 schemes (including 24 on the agricultural side and 15 other schemes) were sanctioned during the year at a total cost of 13¼ lakhs of rupees.

Agriculture

Cereal and other crops

(1) *Rice.* The Council has been financing a large number of schemes on rice research in all the rice growing areas of the Indian Union. As a result of these investigations, a number of rice varieties have been produced through breeding, suitable for varying environmental conditions and resistant to attack of various pests and diseases. The Travancore scheme revealed the possibility of introducing a third crop of rice in a single year in certain areas possessing irrigational facilities. By this method the rice production in the State can be augmented considerably.

In the Kashmir scheme as in previous years, the Chinese varieties of rice have continued to give very high yields. The best Chinese variety was multiplied and about 28,000 lb. of seeds were distributed for cultivation.

Four new schemes for rice breeding were sanctioned during the year, two of which are for deep water paddy in Orissa and Uttar Pradesh. The third scheme is for the improvement of hill paddy in Orissa while the fourth is for evolving better varieties of *Boro* variety in West Bengal.

The Council has also been financing schemes to combat pests and disseases of rice among which mention may be made of the scheme on 'Blast and Foot-rot' disease of rice in Madras State. Two strains (GFR 24 and Ptb. 7) were found to be resistant to the foot-rot disease. It has

been found that the blast disease can be thoroughly controlled by treating seed with organomercuric compounds.

(2) *Wheat.* As the rust disease is a serious menace limiting production of wheat in India, the Council has been focussing its attention on the investigation of wheat rust. Mycological and breeding investigations have been in progress for sometime past and strains of wheat possessing a fairly good resistance individually to one or other of the three forms of rust (yellow, brown and black) have been produced and further attempts for synthesizing strains simultaneously resistant to all the three forms are under way.

(3) *Maize.* As maize is a highly prolific crop and the production of hybrid corn has been known in the U.S.A. to increase yields considerably, three new schemes were sanctioned in the States of Uttar Pradesh, Bihar and Bengal in addition to the two existing ones at Indian Agricultural Research Institute, New Delhi and Punjab.

(4) *Millets.* Considering the importance of the group of cereals known as millets, particularly for areas of low fertility and precarious rainfall, the Council has been financing four schemes for the overall improvement of these crops in Madhya Pradesh, Bombay, Uttar Pradesh and Mysore. Five strains of *'Mandua'* (*Elusine coracana*), four strains of *'Kodon'* (*Paspalum scrobiculatum*) and a strain (Type 25 B) of *'Sawan'* (*Panicum crusgalli*) have been found to be promising in Uttar Pradesh while four strains (Nos. 32, 48, 49 and 85) in *'Same'* (*P. miliace*), seven strains in *'Varagu'* (*P. miliacium*) and five strains in *'Oddalu'* (*Echinocloa frumentacea*) have been found to be oustanding in Mysore. June-August season and red loam soil were found to be better for these crops than October-November season and black cotton soil.

(5) *Pulses.* In view of the nutritive value of pulses particularly in the vegetarian diet in India, a coordinated scheme of research on pulses has been in progress on a country-wide scale. In addition to the yield and quality, the value of pulses in green manuring, rotation and mixed cropping have also been investigated. As a result of the work in progress in the various States, strains of various pulses such as gram, *tur*, *mung*, *urd*, etc. have been produced possessing higher yield, protein content, cooking-quality and disease resistance. Seeds of these improved strains are being multiplied by the State Department concerned for distribution to the cultivators. Improved varieties of Soyabean have been evolved in the Punjab. Soyabean flour has been found to be suitable for admixture with wheat flour in the preparation *chapattis*.

(6) *Spices and condiments.* Schemes for scientific aid to the spices such as cloves and cardamom are also being financed by the Council. The scheme for the cultivation of cloves in Travancore aims at discovering the best practice in plantation management.

Another scheme on Cardamom Research on the Singampati Hills in Tinnevelly District of Madras State has made good progress. The yield of cardamoms, which is a good dollar earner, is inhibited by the attack of insects known as 'thrips'. The work in progress has revealed that these insects can be controlled by dusting the flowers with Gammexane and this discovery is being utilized on a large scale in the plantations.

(7) *Vegetables and fruits.* During the year under report, eight new schemes for the improvement of edible root and tuber crops were sanctioned in the different States with a view to encourage their cultivation and wider consumption to supplement the cereal shortage.

The Council has been subsidizing schemes in Madras, Uttar Pradesh, Punjab, Bihar, West Bengal, Madhya Pradesh, Assam, Hyderabad, Mysore, Coorg, etc. with the object of getting the fruits of best quality with highest yield and to find out remedial measures against insect pests and diseases attacking fruits and fruit trees. In Bihar a list of the economic varieties of mangoes has been prepared and the following varieties have been found outstanding from the commercial point of view, Surkh Burma early (Annual bearer), Aman Ibrahim-Pur, Aman Desheri, Khasul Khas, Husnara and Calcutta Bombai, (Mid-season), Taimuria, Samarbabist of Chausa (late varieties). Among the litchis, purbi, deshi, bedana, dehrarose, and China variety have been found to grow very successfully.

The application of ammonium sulphate alone or mixed with bone-meal to the mango tree in the month of June gave the best results so far as the flowering was concerned.

Work on citrus and mango is in progress in Madras. Amongst citrus varieties, Hawaiian-Pummelo continues to bear big size fruits with a record weight of 8½ lb.

Investigation on the causes of 'black-tip' disease of mango reveals that the occurrence of the disease is not due to any bacteria or fungi and that there exists a definite relationship between the occurrence and prevalence of the disease and the presence of the brick-kilns. It has also been found out that the disease similar to natural necrosis could be reproduced by direct injection of extracts of necrotic mangoes and the extracts of healthy mangoes through which brick-kiln fumes have been passed.

In Assam the optimum season for budding citrus plants has been determined to be from October to January. Exposing seeds of citrus, after extraction from the fruit to the direct rays of the sun for more than four hours, deteriorated the germinating capacity of the seeds.

(b) *Soil Science*

Investigations carried out on the part played by minor and trace elements at Indian Agricultural Research Institute revealed that magnesium and zinc deficiencies are common in citrus orchards in such widely separated regions as the Punjab in the North and Madras and Coorg in the South. Gram diseases such as top yellowing, bronzing and yellowing were traced to boron deficiency at the Indian Agricultural Research Institute, New Delhi and its sub-station at Karnal. Work on nitrogen fixation in soil at the I.A.R.I. has tentatively shown that *arhar* (*Cajanus cajan*) does not depend on the root nodule organisms for its nitrogen.

(c) *Sewage Farming*

Investigations on Sewage Farming at the Indian Institute of Science, Bangalore and Madura and Ahmedabad in collaboration with the municipalities, have revealed that most crops respond well to sewage irrigation, if the soil is fairly porous. Adequate drainage and soil aeration are essential in sewage irrigation. Since sewage irrigation introduces pathogenic organisms, it is recommended that it should not be used in the

case of crops which are eaten raw and not cooked. Fodder crops, however, can be grown on it.

Soil erosion work at Viswabharati, West Bengal, showed that in the prevention of 'run off' *sabai* grass as well as cowpea had their own points to commend. A new scheme for soil conservation in Himachal Pradesh has been sanctioned during the year.

(d) *Plant pests and diseases*

Pests and diseases of crop plants is a serious menace to crop husbandry. The Council has been fully aware of this and financing a number of schemes all over the Union on various aspects of this problem. Tests with DDT and other allied insecticides were carried on at the I.A.R.I., Bombay, Uttar Pradesh, and Madras. BHC and DDT sprays at 0.1 per cent concentration effectively controlled paddy thrips in Madras; the former, however, was more promising than DDT. The yields of rye seed and potato tubers in the DDT treated plots were significantly higher than in the control plots in Uttar Pradesh. Five per cent BHC (as Hexyclan or Gammexene) gave complete control of paddy grass hoppers in Bombay; DDT-Sulphur mixture, half and half or two to one, also gave cent per cent reduction of hoppers. The cooperative experiments on fungicidal sprays at Madras, Mysore and at the I.A.R.I. indicated that none of the new fungicides was likely to replace Bordeaux mixture.

In the plant virus investigations at Poona, insect vectors of the 'Kette' disease of cardamoms, 'Rogose' mosaic of tomato and mosaic of papaya were established; the sterility of *arhar* on the other hand is suspected to be non-pathogenic.

Animal Husbandry and Dairying

General

An all round appreciable progress was maintained in the various animal husbandry schemes on livestock breeding, feeding, disease control, dairying, etc. Satisfactory progress has been made in the development of Hariana and Kangayam for a 'dual purpose type', as a good number of experimental animals have yielded over 2,000 lb. of milk. The Council has sanctioned 'Pilot Key' village schemes for the improvement of cattle in Travancore-Cochin, Uttar Pradesh, Delhi, Orissa, Saurashtra, Hyderabad and Gujerat, of which the first three will be initiated this year.

Livestock Breeding

An important feature was the Food and Agricultural Organization Conference on Livestock Breeding under tropical and sub-tropical conditions held at Lucknow. Sardar Datar Singh (India) was elected its Chairman and representatives of various member countries gathered there discussed the problems concerning livestock in their countries and certain positive measures of improvement were recommended by the Conference.

The various sheep and goat breeding schemes financed by the Council showed steady progress. At Hissar a better woolly type flock has been evolved. Due to introduction of foreign blood, a Kashmir Merino type sheep with better wool has been evolved. Similarly in Madras a white woolly type sheep has been evolved by grading Bellary ewes with Bikaneri rams. In the Angora goat breeding scheme a higher yield of Mohair was obtained. Mohair with greater length, fineness and absence of medullation was produced.

Vanaspati

The nutritive value of Vanaspati, etc. was determined at the Indian Veterinary Research Institute. As a result of this, cow *ghee* was found to be superior to the rest of the fats, oils and Dalda. There was, however, no great difference between Vanaspati Dalda and other vegetable oils.

Dairying

Under dairying, keeping quality of market milk was studied and it was found that by adoption of proper methods, milk can be kept for 24 hours and transported to 150 miles. Bacteriological quality of market milk was studied and a large number of samples were tested for this during different seasons. A comprehensive scheme to establish a standard market quality of *ghee* is working at the Indian Dairy Research Institute.

Disease Investigation

The Disease Investigation Schemes in States made considerable progress. For the control of rinderpest, the viability of different vaccines in use were tested and the duration of immunity conferred by them under different conditions was studied. Brucellosis was another important disease investigated in several States where a large number of animals were tested to find out its incidence. Vaccination of cattle with Muktesswar vaccine gave fairly satisfactory results. At certain Farms calfhood vaccination was also found effective. To find out the incidence of tuberculosis in animals, a large number of cattle were subject to tuberculin test in the various States and wherever possible necessary measures were adopted to segregate animals found suffering from this disease. It may be mentioned that as a result of repeated testing and segregation of the affected animals the incidence of tuberculosis at the Livestock Farm, Hissar, was considerably reduced during the past few years. Other important diseases encountered and investigated during the year were Surra. Hæmorrhagic Septicæmia, Nasal Schistosmiasis and Bovine Contagious Pleuro-pneumonia. Sheep and goat pox was found to be very common in several States. Vaccination gave satisfactory results. Among the poultry diseases, Ranikhet disease was the deadliest one and resulted in the largest mortality in poultry. Its incidence, epizootology, etc. was studied. A large number of birds were inoculated with Ranikhet disease vaccine in different States with encouraging results. Besides this, other poultry diseases like, Fowl-pox, tuberculosis, Spriocætosis, Coccidiosis, and helminthic infestations were investigated and necessary treatment was provided.

Animal Pests

Under the Council's schemes for Helminthic infestation of cattle, sheep and goats, the life-history of some of the important parasites was studied. As a curative, carbon tetrachloride, hexachlorethane, phenothiazine, copper sulphate, etc. were tried with encouraging results. In Madras toxic principles of several indigenous plants were studied and efforts were made to find out suitable antidotes.

Incidence of warble fly infestation and the damage caused by these has been studied. Preventive and curative methods for its control have been perfected.

Research Fellowships

The Council has sanctioned Research Fellowships of duration of two years in Animal Pathology, Bacteriology, Physiology, and Parasitology and Genetics.

Statistics

The Statistical Branch of the Council continued its advisory and teaching functions, the number of officers trained in agricultural statistics during the year being over forty.

In the sphere of statistical projects, the technique of random sampling survey was extended to the study of two important problems. One of these was a survey for estimating additional food production as a result of the distribution of G.M.F. measures carried out in Madhya Pradesh, Bombay and Uttar Pradesh. The results obtained, while not being conclusive, suggested that official claims of additional production were somewhat exaggerated. The other survey was for the estimation of marine fish initiated in Malabar Coast. Work was also done, in addition to these, towards unification and standardisation of the surveys initiated in 1943 for the estimation of wheat and paddy production in the country.

Under the joint auspices of the Government of India, the F A.O., UNO, E.C.F.E. an International Training Centre on applied agricultural and demographic statistics for the benefit of the countries of South East Asia and Oceania was held in New Delhi, under the administrative control of the I.C.A.R., for a period of 14 weeks from November 1949 to January 1950. The main purpose of the Training Centre was to help member Governments in developing their censuses and sampling techniques as applied to population and agriculture and to disseminate information on international recommendations regarding world agricultural and population censuses to be taken up during 1950-51. In addition to delegates from States of India, over 35 delegates from Burma, Pakistan, Nepal, Indonesia, Ceylon, Indo-China, Korea and Thailand participated in the Training Centre.

Delhi Development Scheme

The Delhi Development Scheme aims at developing a compact group of villages in Delhi State by the practical application of the results of research. Delhi was chosen because of the availability of the expert Advisers of the Council and other Government Departments whose advice could be readily obtained. The programme of work includes the following:

1. Encouraging mixed farming.
2. Increasing the area and yield of food crops by introduction of improved seeds, implements, better use of manures and fertilizers.
3. Conserving cowdung for manurial purpose, planting fuel trees, providing silage-pits and sullage from the Municipality.
4. Improving the existing breeds of cattle for draught and dairy purpose by castrating scrub bulls and introducing improved breeds.
5. Encouraging cottage industries like poultry, pigs and fish culture.
6. Improving social and cultural life of the villagers by creating an interest among the villagers in Development Schemes by organising village *panchayats*.

The Scheme has been in operation since April 1948 and it is already showing progress in certain directions. On the agricultural side improved seeds of both *kharif* and *rabi* crops, fruit plants, as also improved ploughs have been introduced. On the animal husbandry side, arrangements were made for the castration of scrub bulls and for the supply of new bulls of known pedigree; Desi cockerels have been replaced with improved types of poultry; and improved Yorkshire boars have been supplied for breeding purposes. Fries were introduced into about half a dozen tanks of some villages and those matured into full grown fishes were sold in the market thereby proving a source of income to villages.

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CHAPTER I.—ADMINISTRATION

General

This is the 20th Annual Report of the Indian Council of Agricultural Research covering the period from 1 April 1949 to 31 March 1950, presented by its Governing Body under Rule 64 of the Rules and Regulations of the Council.

Meetings

During the year under report, the following meetings were held:

(i) Scientific and Commodity Committees, November 1949.

(ii) Annual General Meeting, 1 December 1949.

(iii) Advisory Board, 1 and 2 December 1949.

(iv) Standing Finance Committee, 9 January 1950.

(v) Governing Body, 10 January 1950.

The Hon'ble Shri Jairamdas Daulatram, Minister of Food and Agriculture, Government of India continued as *ex-officio* Chairman of the Indian Council of Agricultural Research and Sardar Datar Singh, as Vice-Chairman. Shri S. M. Srivastava, I.C.S., Secretary of the Council, officiated as its Joint Vice-Chairman from 11 May 1949 to 4 December 1949 and Shri T. S. Krishnamurti, Under Secretary of the Council, officiated as its Secretary from 11 May 1949 to 7 February 1950. Consequent on the sad demise of Shri S. M. Srivastava, on 4 December 1949, Shri S. R. Maini, I.A.S., Deputy Secretary, Ministry of Agriculture, Government of India, joined the Council as its Secretary, on 8 February 1950.

In addition to the Council's current schemes aggregating 268 (126 on the agricultural side, 114 on the animal husbandry side and 28 under miscellaneous headings), 47 new schemes were sanctioned, during the year, at a total cost of Rs. 13.25 lakhs (round) to the Council as follows:

Agricultural schemes, 24; animal husbandry schemes, 15; other schemes, 8. Funds to the extent of Rs. 10·7 lakhs were also provided for the extension of 75 current schemes which were due to expire during the year.

During the year under report, the following States were admitted as members of the Indian Council of Agricultural Research:

(i) State of Travancore-Cochin on the integration of the States of Travancore and Cochin.

(ii) State of Rajasthan on the merger of States of Jaipur and Bikaner with it.

(iii) State of Saurashtra.

Finance and Accounts

The following were the receipts from the (i) cess levied under the Agricultural Produce Cess Act, 1940, and (ii) the grants received from the Government of India:

	Rs.
(i) Receipts from A.P. cess	24,84,160
(ii) *Grants-in-aid*	
(a) Scheme of Crop-yield Estimation by Aerial Photography	2,375
(b) Co-ordinated Research Scheme for control of Wheat Rust in India	63,000
(c) Crop Cutting Experiments, Wheat and Paddy . .	1,86,000
(d) Indian Institute of Fruit Technology . . .	72,200
(e) Scheme of Insect Pest of Stored Oilseed . . .	147

A statement showing the audited accounts of the Council for 1949-50 is appended (Appendix).

CHAPTER II.—AGRICULTURAL RESEARCH

General

The eighth meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry was held at Patiala from 28 to 31 March 1950. About a hundred delegates from all parts of the country attended the meeting. After the inaugural address on the first day by His Highness the Rajpramukh, Patiala and East Punjab States Union, the Session split into six committees to consider the six subjects on the agenda. The Committees met on 28 and 29 March, and the full Wing on 30 and 31 March to consider the reports of these Committees.

This opportunity was availed for calling a Conference of the Entomological and Mycological workers, separately on 27 March, and jointly on 28 March 1950. This is in pursuance of the policy of the Council to call periodic conferences of research workers in different branches of agriculture and animal husbandry.

The subjects considered by the Crops and Soils Wing and some of the more important recommendations, made on each subject are given below:

1. *Measures to be adopted for increased production of alternate food crops, particularly root crops like tapioca, sweet potatoes, etc. for making up the deficit of food grains in the country*:

(i) The various State Departments should survey their respective areas to find out details regarding the various types of edible and tuber crops available in their respective regions.

(ii) The nutritional value of these crops should be investigated before their extended cultivation is recommended.

(iii) For immediate cultivation potatoes, sweet potatoes and green bananas which contain nutrient elements might be cultivated, without encroaching on land under cereals and other food crops.

(iv) The Horticulturists in various States should examine the possibilities of extending the cultivation of fruit trees.

(v) Short notes on important agricultural subject in suitable forms should be introduced in the text books and rapid reading books prescribed for primary and high schools in the country.

(2) *A critical review of the causes for the consistently low yields of major food crops in India as compared to other countries and measures necessary to improve them both quantitatively and qualitatively*:

(i) There is need for rational crop planning in the country. The Government of India should therefore take steps to establish a Central Crop Planning Committee for preparing a rational plan for crop production so that lands might be utilized for the crops for which they were best suited.

(ii) Legislation may be enacted on the lines adopted in the Punjab for an extensive use of better seeds.

(iii) The seed multiplication schemes may be carried out; compost making should be encouraged; prevention of using dung as fuel should be encouraged.

(iv) The compulsory Consolidation of the Holdings Act recently passed by the Punjab Government was supported and commended to other States; further steps should also be taken to prevent fragmentation of consolidated holdings beyond certain limits.

(v) Remission of water rates on green manure crops and also free supply of seed in the beginning, as is the practice in the Punjab, was recommended.

(vi) Rotation of crops should be introduced.

(vii) Maximum number of model farms on private lands should be established as these would serve as effective demonstration for cultivators.

(3) *Measures to check weeds in the fields of food crops with a view to save the loss caused by them with particular reference to chemical methods employed in other countries for this purpose*:

(i) A list of weeds and the crops with which they are associated should be compiled and each State should maintain herbarium specimens.

(ii) All cultural methods of control which are feasible should be intensively practised.

(iii) As control by selective herbicides offers the greatest and quickest possibilities of check work, planned and comprehensive experiments should be undertaken in each State with the financial help of the Indian Council of Agricultural Research and the Central Government should make arrangements for the import of selective herbicides on a large scale for carrying out these experiments.

(iv) Immediate attention should be paid to the eradication by selective herbicides of such extensively spread weeds like water hyacinth, Lanteus, *baisurai* and *pohli*.

(4) *The need for establishment of seed testing stations in India for maintaining the purity of the seed-material and its freedom from seed-borne organisms, seed-weed contents, etc. as a measure to increase crop yields*:

(i) The need for establishment of regional seed testing laboratories was emphasised by the Wing.

(ii) These regional seed testing stations should be selected at the agricultural colleges or Research Institutes now existing which have a full complement of technical staff.

(iii) The Central Government should enact legislation on the lines of the Seed Act which is in force in the United Kingdom, United States of America, Canada and other countries.

(5) *Scope and Manner of Utilization of Chemical Fertilizers and Composts*:

(i) Maximum possible use should be made of chemical fertilizers in combination with organic matter like farmyard manure and compost.

(ii) The importance of collecting adequate data based on experiments in Government farms as also on farmers' plots for creating the confidence of farmers in departmental recommendations should be emphasized.

(iii) Experiments on the farmers' farms should be extensive and supplemented by demonstration plots in departmental farms.

(iv) Every effort should be made to persuade the farmers to adopt recognized methods for better utilization of cattle urine in cow sheds or wherever cattle are kept in large numbers.

(6) *The best possible organization for extension and development work in agriculture in India for increasing agricultural production*:

(i) An organization for extension services should be set up according to a standard plan in the various Departments of agriculture so as to accelerate agricultural production. The Council was authorized to finalize proposals in this respect and to circulate them to the various State Departments concerned.

Main Recommendations of the Mycological, Entomological and Joint Conferences:

(i) Work on 'Brown-rot' and 'Ring-rot' of potatoes and guava and cotton disease should be taken up on an all-India basis.

(ii) The Universities should be asked to consider 'Mycology and Plant Pathology' as an independent subject. The Universities should also take up research in Medical and Industrial Mycology.

(iii) Work on virus diseases of plants should be co-ordinated on All-India basis by the Head of the Division of Mycology at the Indian Agricultural Research Institute and a scheme with that object in view should be prepared and submitted to the Council.

(iv) For experimental purposes, at least, Entomologists should devise their own formulations of synthetic insecticides.

(v) Need for the proper application of the insecticides by various types of spraying and dusting equipment was stressed.

(vi) The plant protection work (development work in Entomology and Plant Pathology) everywhere should be under one unified control both technically as well as administratively.

(vii) In view of the close interdependence of research and plant protection work everywhere the Conference unanimously recommended that the two should be under one unified control and direction

(viii) A National Entomological-Mycological Laboratory for Entomological and Plant Pathological research, the results of which may find practical application not only in agriculture but also in medicine, forestry, and veterinary science, be established.

(ix) A Central Organization for giving training in Plant Protection methods should be set up.

(x) The necessity for a Central Organization to undertake and arrange for rapid testing of new insecticides and fungicides was recognized and it was agreed that the testing work should be done by the Centre.

(xi) The publication of standard coloured plates and preparation of films dealing with major pests and diseases of crops was considered an urgent necessity.

Rice

Breeding

In the field of crop production in India, rice occupies the foremost place. The Council has given a great impetus to its improvement by subsidizing, since its establishment, a chain of research schemes in Bengal, Orissa, Uttar Pradesh, Madhya Pradesh, Assam, Madras, Baroda, Mysore, Travancore, Kashmir, Hyderabad and Bombay. The majority of these schemes terminated between 1941 and 1945. As a result of investigations on the breeding side a large number of varieties have been produced, suitable for varying conditions, such as high and low lying areas, resistance under flood, drought and saline conditions, resistant to the attack of insect pests, diseases, etc.

An interesting result of the experiments carried out under the Rice Breeding Scheme, Travancore, which terminated last year, is the possibility of introducing a third crop of rice during the year in some areas of Travancore where irrigation facilities exist. It has been found that Ptb. 10 grew successfully in these areas between January to March provided water was available, thus increasing the crop yield by about 50 per cent over present production. Multiplication and distribution of improved seed has been taken up by the State Government. A total quantity of about 33,000 pounds of seeds of No. 1 and 2, and Ptb. 10 has already been distributed to the *ryots* and a quantity of about 1,60,000 pounds is in hand for distribution in the next crop season.

During the year, six schemes on rice breeding were in operation in Bombay, Hyderabad, Kashmir, Punjab, West Bengal and Coorg. The first scheme is due to terminate early in 1950, the Hyderabad and Kashmir schemes in 1951 while the last three are new schemes which were put in operation late in 1949.

At the Nawagam station of the Bombay Scheme, the promising selection from the five varieties taken up for improvement could not be tried in replicated yield trials on account of the failure of rains.

As an emergency measure these were only maintained under well irrigation for obtaining their fresh seed for the next year. At the Bubar station, third year's promising selections from the main varieties, *viz.*

Kada, Wankvel, Early Kolam and Late Kolam were put into large scale replicated trials. The performance of Kada selections was very promising and selection No. 176—12 was found to be the best giving 22 per cent significantly higher yield than the local. This will be tried in the district next year.

In the Kashmir Scheme, studies on exotic (Chinese and Russian) varieties were continued. As in the previous years, the Chinese varieties of paddy gave a very high outturn. The best Chinese variety was multiplied and about 28,000 lb. of seeds were distributed for cultivation.

In the Hyderabad Rice Improvement Scheme fertilizer experiment with late HSI showed that 45 lb. of Nitrogen per acre in combination with P. either at 30 or 15 lb. per acre gave highest yield, a dosage of K_2O or its absence having had little effect. Similarly with late HS 35, higher dose of nitrogen has tended to give higher yields in combination with either 15 lb. or 30 lb. P_2O_5 per acre. The addition of K_2O again had little factor. This again corroborates the view that nitrogen is the deciding factor. The application of oil-cakes (to supply 30 lb. N) resulted in higher yield, groundnut cake having fared better than castor cakes.

Four new schemes on rice breeding were sanctioned during the year. Two of these are for investigations on the problems of deep water paddy in Orissa and the Uttar Pradesh. It is estimated that in Orissa more than two lakh acres of cultivable land remain fallow due to submergence in water up to 20 feet depth while an equal area can be reclaimed in the eastern districts of the Uttar Pradesh. If varieties that can be cultivated in water from 10 to 20 feet can be evolved, these four lakhs of acres can be brought under cultivation. The two schemes are meant to solve this problem.

The third scheme is for the improvement of Hill Paday in Orissa. The object of the scheme is to introduce in the State improved varieties of paddy suitable for high elevations and their improved methods of cultivation so as to raise the economic life of the local people by increasing the yield of paddy per acre.

The last scheme is for evolving better varieties of *Boro* paddy in West Bengal. *Boro* rice (spring rice) is a marshland paddy sown on the margin of 'beels and hoars' (large natural depressions) where water accumulates during the monsoon and the water level gradually recedes and the land becomes fit for cultivation by November to December. *Boro* is sown in seed bed in November, transplanted in December to January and harvested in April to May. *Boro* paddy occupies a little over a half a lakh of acres in West Bengal. The object of the scheme is to select high yielding and good quality types of *Boro* paddies.

Pests and diseases

In the Blast and Foot rot disease in Madras, the resistance of 300 varieties of rice to Blast was evaluated by growing them under conditions favourable to the spread of infection. They were further subjected to artificial inoculation under controlled conditions. The factors responsible for disease resistance in rice were studied when it was revealed that the number of silicated epidemal cells per unit area in the resistant type was

greater than in the susceptible ones. Two strains (G.E.B. 24 and Ptb. 7) proved highly resistant to the foot rot disease. Trials with four fungicides (Certosan, Atiran, Ceresan and Agrosan) revealed that though all of them were effective in controlling the disease to a certain extent, the latter two were better. The dosage used was 1 gm. of fungicide for one pound of seed.

Wheat

In wheat the intriguing problem is that of rust and it is further complicated as all the three forms of rust appear in India whereas in other countries usually one or the other form occurs. The Council is, therefore, focussing its attention on this important problem. The investigations so far undertaken at Indian Agricultural Research Institute, Bombay, Madhya Pradesh and Agra have resulted only in partial success, i.e. varieties resistant to one or the other forms of rust individually have been produced. The next and more arduous phase of the problem, i.e. producing a variety which will be resistant to all the three forms of rust, has been taken up. To accelerate this process a comprehensive Coordinated Scheme for the control of wheat rust (mention of which was made in the previous report) has been sanctioned for a period of 3 years with possibilities of further extension for another 2 years. The scheme is in two parts, viz. Mycological and Botanical, the former part to be worked at Agra to Delhi and Simla and the latter part to be worked at Delhi, Simla, Pusa and Indore—the last two being new centres. The previous scheme for the breeding of rust resistant wheat at Simla under the Director, Indian Agricultural Research Institute, and the schemes for the investigations of cereal rust at Agra have merged into this scheme.

The existing Wheat Rust Schemes at Hoshangabad in Madhya Pradesh and at Mahableshwar in Bombay have yielded useful results and will continue as before, as they concentrate on problems relating to Black Soil areas in the Deccan. The tenure of the former is upto 1952 and that of the latter upto 1951.

It is expected that as a result of all these investigations varieties will be evolved which will be resistant to all the three rusts and agronomically suited to the major wheat tracts. When this is done it will be the first achievement of its kind in the world.

Maize

Maize is highly prolific crop and it can play a very important role in making good the deficit in our food supply if arrangements can be made for the production of hybrid maize seed.

The Council has, therefore, sanctioned schemes for the production of hybrid maize at the Indian Agricultural Research Institute, Punjab, Uttar Pradesh, Bihar and West Bengal. The schemes at the former two centres are in a fairly advanced stage while these have only started recently at the last three centres.

Till such time as our own stations are able to produce hybrid maize, arrangements have been made by the Government of India to import, through the help of the F. A. O., a large number of commercial hybrid seeds from the U.S.A. for testing, at a number of experimental centres, to select the varieties most suited to the various maize tracts in the country.

The following results have been reported by the Indian Agricultural Research and Punjab maize breeding station.

Indian Agricultural Research Institute. Out of the collection of 111 indigenous and 32 open pollinated exotic varieties, 29 and 6 varieties respectively, were selected on their desirable morphological and physiological characters.

From 57 ear to row (cultures) of better cobs, selected in the previous year from both indigenous and exotic varieties, 60 pairs of comparable selfed and sibbed lines have been started. Thirty nine crosses between lines selfed for one ear were made as also 12 crosses between 2 ear selfed lines. These individual lines were further selfed.

Of a number of single and double crosses involving Indian and foreign inbreds, 3 double crosses appeared promising. Nearly 700 inbred lines have been started from both Indian and foreign varieties to build up a basic collection of inbreds to develop desirable single and double crosses of diploid and polyploid origin. Six single crosses involving 9 inbreds were made; 3 single crosses obtained previously were backcrossed to each of their two parental inbreds resulting in six back cross progenies.

Punjab. The botanical and agronomical characters of 108 indigenous and 7 exotic (U.S.A.) commercial varieties were studied at the Maize Breeding Station, Jullunder.

1. In the inbreeding work with selected promising plants the effect of selfing on vigour and homozygosity of resultant inbred lines was noted. Punjab 40-3, Punjab 40-3A and Punjab 449-4, however, maintained considerable vigour in respect of one or the other characters even after successive generations.

2. In cross breeding work, in all, 31 top crosses were attempted with $19S_3$, $4S_2$, and 2 exotic inbred lines on the one hand and Jullunder Local, Nagrota Local, Kulu Local and Bihar T as open pollinated varieties on the other hand; 89 single crosses were done between 26 inbred lines. Ready made crosses from the U.S.A. and Canada were also imported.

3. Pollination studies showed that under Jullunder conditions a distance of 500—600 ft. between maize fields is sufficient to prevent natural crosses. As to the best ratio between pollen and pistillate parent rows for production of hybrid seed, practically no difference was found between ratios tried.

4. In progeny row test at Kulu only 2 varietal crosses (Punjab 61 X Punjab 63 and Bihar 1 X Punjab 64) gave higher yields (4.0, 41.4 per cent respectively) than the local. At Jullunder yellow grain Top crosses, Punjab 68-2-2 out yielded the local by 47·25 per cent. In white grained crosses, 10 out of 23 gave higher yields (ranging from 3·4 to 4 per cent) than standards.

Soyabeans

The scheme for research on soyabeans sanctioned in the Punjab terminated in March 1950. Both at Ludhiana and Jullunder Otatootan, a black seeded variety was found to be the highest yielder followed by Behrum-14. From amongst the varieties tried at Kangra, Nanking 373 gave the highest yield. At Karnal and Hansi, both places characterized

by droughty conditions, Shillong No. 1 proved to be the best yielder. Experiments on the composition of the different varieties of beans have shown that yellow varieties, as a class, exhibit higher protein content but lower 100 grain weight, calcium and phosphorus contents as compared to the black varieties. Experiments on sowing date and seed rate have indicated that the composition is not affected by sowing date or seed rates. The possibility of consuming soyabean in the form of wheat-soyabean mixture *chapatis* offers scope for popularizing soyabean consumption in the country. Salted *chapatis* prepared from even 100 per cent soyabean meal tasted well. The most characteristic feature of wheat soyabean mixture *chapatis* was their superior nutritive quality in respect of protein and fat contents. *Chapatis* prepared from a 50:50 mixture of wheat and soyabean were twice as rich as wheat in protein content, while fat content was increased manifold as compared with that of wheat *chapatis*. Yellow varieties of soyabean have been found to be decidedly superior for being mixed with wheat for this purpose.

Pulses

Pulses play a vital role in Indian diet as they form the main source of proteins for the large vegetarian population in the country. India possesses a wealth of pulses such as *arhar*, *mung*, *chana*, *urd*, peas, horse gram, etc. Since 1943 the Council has been financing coordinated pulse research schemes at a number of centres with the object of producing high yielding disease resistant types possessing commercially desirable qualities. The value of some pulses in green manuring, rotation and mixed cropping was also taken up for investigation. The results of those investigations during the year under report are given below:

Madras. At Coimbatore, Green gram selection No. 62, Black gram Nos. 281 and 284 and Bengal gram No. 94 gave significantly higher yields than their respective controls. In horse gram 14 cultures yielded more than double the control. Three cultures were found promising in cowpeas. Red gram strains of Dharmapuri which gave extra yields ranging from 5 to 37 per cent over controls in 10 centres were sent out for trial under cultivators' conditions.

Culture No. 127 of Green gram gave 42 per cent more yield than control in dry land conditions at Vizianagram, while No. 188 gave the highest yield under wet land conditions at Samalkota. Black gram strains 105 and 109 and another set of 6 strains gave significantly higher yield than their controls.

In mixed cropping experiments at Coimbatore, combination of Red gram and *varagu* gave the highest monetary return for the S.W. monsoon season while a pure crop of *Tenai* gave the highest outturn for the N. E. monsoon season. On the other hand a combination of pure *ragi* crop followed by horse gram gave the highest monetary return per acre at Vizianagram.

Bombay. In a yield trial with gram at Karad Farm, out of 7 strains one strain (Himayatsagar 9-2. etc.) yielded better than all the rest including local. Trial at Dharwar Farm showed that 6 cultures (Dohad 206, etc., Dohad 1597, etc., Dohad 206-8-3, etc., Nagpur 2, etc., Nagpur 1, etc. and

Ghafa 2r 1, etc.) combined wilt resistance with good yield. Out of the 43 hybrid cultures raised in F4 generation in wilt sick soil, 3 resisted wilt 100 per cent, while 4 other cultures resisted it upto 98.5 per cent.

In *matki* (*Phaseolus aconitifolius*) out of the 9 promising strains tried in an yield trial at Karad Farm and in four Government Farms, with local as the check, four selections (Nadia, Yawal, Jaguban and Jalgaon) proved superior.

In *mung* (*Phaseolus aureus*) out of the four selections tried on a large scale at Karad and Jalgaon Farms as well as in two places in the districts, it appeared that two Jalgaon strains and one Sind Kheda strain are superior to the local variety. In *tur*, (*Cajanus cajan*), three high yielding selections (M 7-6, etc. M4-17, etc., M4-7, etc.) out of 22 tried at Arhhavi Farm have proved to be over 90 per cent resistant to wilt in artificially infected plots and have outyielded the local check.

Uttar Pradesh. As in previous years type 66 in *arhar* strains gave significantly higher yield than others at the trials at Kalianpur, Etawah and Jhansi and the cooking tests strain 17/W/2 produced the best *dal* followed closely by type 66. Similarly in *urd* strain 12/5 produced best *dal* followed by 8B/12.

Among the soyabeans C22 gave the highest yield at Kalianpur. In gram type 87 was the best yielder. It was also the best for *dal* as well as for parching followed by N.P. 25 and Banda.

In the mixed cropping experiments for yield *arhar—jowar* line sown gave the highest outturn followed by *arhar* pure. In the mixed cropping experiments to reduce wilt incidence it was found that there was a markedly lower wilt incidence (70 to 44 per cent) in all plots when *arhar* was grown mixed with *jowar* as compared to the incidence in pure *arhar* plots (76.9 per cent); the lowest incidence (40 per cent) was in plots when *jowar* remained till maturity; followed by plots when *jowar* was removed at flowering (54.65 per cent) and the plots from which *jowar* was cut at an earlier fodder stage (70 per cent). The effect of *jowar* crop in reducing wilt incidence is thus clearly indicated.

Assam. As a result of preliminary trials with *mati kali* (*Phaseolus mungo*) strain No. 18, a higher yielder, has been provisionally selected for multiplication in acres of land for distribution to seed farmers and selected growers. Experiments on the time of sowing have indicated that sowing on 22 August and 19 September had the same effect while sowing on 27 September and 15 October gave poor yield. In the case of *mung* (*P. radiatus*) sowing on 22 August gave the best result with a yield of 1,200 pound per acre followed by the sowing on 9 September with a yield of 815 lb. per acre. Experiments on seed rate have indicated that the best yield is obtained with a seed rate of 8 seers per acre

Bihar. Improved strains have been evolved, e.g. No. 13 in early *rahar*; No. 34 in medium *rahar;* Nos. 15, 16 and 7S in late *rahar* spreading type and 10, 17 and 2 E in erect type; No. 77 in gram; No. 2/10 in green grain yellow seeded strain; No. 4/3 in green seeded strain and 2/1/8 in black seeded strain, etc. The scheme terminated in March 1950 and further multiplication and distribution of the improved strains will be undertaken by the State Department.

Gwalior. At Gwalior centre, among the early group, a local variety of *mung* recorded the highest yield of 525 lb. per acre followed by Sardarpur 4 and 16 In the late group Blind No. 3 recorded highest yield of 467 lb. per acre followed by Khachraud No. 5 while Jagudan 17, and Bhilsa green were the promising late types in Ujjain centre. Among the late *urd* Jora 25 and Mungaloi gave higher yields of 17 per cent and 8 per cent respectively at Gwalior, while Bhilsa green 15 and 110 showed promise in Ujjain centre. In the early varieties Shivpuri and Jora 4 also were outstanding at Ujjain Centre. Among late *arhar* strains tried at Gwalior local recorded the highest yield of 1344 lb. per acre with Khachraud 7 coming second. E.B. 3 from Hyderabad, E.B. 3 from Nagpur and Ujjain, showed great promise among early strains in Ujjain centre.

In gram types, Bijeypur 3 and Morena at Gwalior and Saboor 2, and Sardarpur 21 among early groups at Ujjain showed promise. For trial with promising commercial varieties D.H. recorded highest yield of 665 lb. per acre while Bhilsa gulabi 2 and Bhilsa Kabuli No. 2 gave 616 lb. and 569 lb. per acre respectively.

Mysore. In *tur-togari* (*Cajanus cajan*) nine strains (Tho 137-001, Tho 203-041, Tho 191-013, Tho 167-018, Tho 147-013, Tho 007. Tho 129-008 and Tho 192-032) evolved by selections are in multiplication plots prior to distribution to the *ryots*. These are draught resistant, free from disease and are heavy yielders giving on the average 450—600 lb. of seed per acre.

In gram *kuethi* (*Delichos biflorous*) a selection known as 'Black Harali' Chick Magalur B have been found to be the best and are being multiplied.

In gram *kuethi* (*Delichos biflorous*) a selection known as 'Black Harali' has given the best yield (600—800 pounds per acre) and is very draught resisting. This is now being multiplied and issued for trial in cultivators' fields. Under soyabeans two varieties K 16 and white Mamoth (yield 800—1,200 lb. of grain) have done very well and are under multiplication.

Orissa. In *mung* selection Nos. 2105, 150, 28 and 1630 have been evolved which have given higher yield than the local Barpal *mung*. In *biri* selection 1601 has given consistently high yield (580 lb. per acre).

In *kulthi* selection Nos. 42, 32, 37 and 23 have given very promising results. Results on mixed cropping with (1) *biri* and *biali* paddy and (2) *arhar* and *biri* are not conclusive.

West Bengal.—The scheme has just started.

Physiology of pulses, Presidency College, Calcutta. Fundamental investigations are being undertaken in this scheme. Some of the results recorded so far are given below:

In Kishoregunge Sona mung September was found to be the best sowing time. In *mung* I.P. 28 vegetative growth in July and November sowings was not as good as the April and May sowings though better than the October and December sowing. In lentil 5 there was no germination from April to August; the vegetative growth was best in the sowing of October, November and December; but of these sowings only the November sowings in plots and October and December sowings in pots produced flowers and fruits.

In the vernalization experiments in both the varieties of *mung*, presowing cold treatment (2° to 40° C.) for 30 days inhibited germination and the flower and fruit formation in the few plants that germinated. In Barisal lentil Hyb. I presowing cold treatment had a very favourable effect both in vegetative and reproductive growth, but in lentil No. 5 the reaction seemed to be the reverse. The scheme is due to terminate in June 1950.

Gram wilt disease scheme, Punjab. The wilt disease is causing considerable damage to the gram crop in the Punjab estimated at over two crores of rupees annually. A scheme is being financed by the Council since 1943 to investigate the life history and causes of gram wilt and devise simple measures for its control and discover types resistant to it. It is reported that experiments conducted for the fifth year in succession have failed to establish a pathogen as the cause of gram wilt as it occurs in the Punjab. Non-biological agencies such as unfavourable soil conditions, deficient soil moistures and high temperature at the time of sowing and towards the end of the gram season are considered by the workers to be the main causes of wilt in gram.

Millets

Of the four schemes for the improvement of millets financed by the Council the Madhya Pradesh and Bombay Schemes have terminated. In the former improved strains have been evolved and these are being multiplied by the State Government. In the case of the latter no final selections have been made and the Bombay Government is continuing the research work. The results of the Mysore and Uttar Pradesh schemes are given below.

Mysore. At Irwin Canal farm *same* (*Panicum milliare*) selections 32, 48, 49, and 85 have given a yield of more than 800 lb. per acre, the last yielding 1,120 lb. against 480 lb. of the control.

In *barau* (*Panicum miliaceum*) too, 7 selections of black series (88 Janukonoda, 90 Hariahar, 91 Holakere, 127 Sirumpur, 82 Coimbatore, 89 Davangers, 128 B Ceylon yielded more than 1,100 lb. per acre, the first yielding 5,120 lb.; eight other strains tried in same farm from the line cultures have also yielded more than 1,200 lb. per acre, 86 Chital-drug at the top with 1,820 lb. per acre.

In *oddalu* (*Echinocloa fromentacea*) out of 15 strains tried at Irwin Canal farm 5 have yielded more than 600 lb. per acre. The seasonal trials indicated that *mungar period* (June to August) was more suitable than *hingar* (October to November) for these 3 millets and that they thrived better in red loamy soils than in the black cotton soils.

Uttar Pradesh. Mandua (*Eleusine coracana*) strains H. 80, H. 87B and H. 120 gave good yield in the preliminary trial at Tarikhet centre. In the varietal trial two, H 104A and H 120, yielded higher than the local.

In *swan* (*Panicum crusgalli*) trials at Ghorakhpur and Bahraich showed that type 25B has a very high yield As such this has been selected for multiplication. Four strains of *kodan* (*Paspalum scrobiculatum*) out yielded the local in a preliminary yield trial.

The two new schemes sanctioned last year, one for the control of *Striga* on sorghum, the other for the multiplication and distribution of Hybrid *Cumbu* seeds in Madras have been put in operation during the year.

Other Crops

Sunn-hemp—Uttar Pradesh. A 5 year scheme for the improvement of sunn hemp in Uttar Pradesh financed by the Indian Council of Agricultural Research from 1944, terminated last year. The Sorum *tehsil* of Allahabad produced sunn-hemp which had about 75 per cent. of sticks. An area comprising 20 villages was therefore selected and the programme of work included distribution of selection seed, organization of cooperative societies, introduction of better retting methods of improved retting of the fibres and in preparing clean hemp by eliminating the 'Lakharia' fibre. The final report of the scheme has recorded that the work has led to the introduction of improved and selected seeds in about 50 per cent of the area under sunn-hemp. It has also been estimated that as a result, the income of the cultivators has risen by about Rs. 30—35 per *bigha*. To a very limited extent. the 'Lakharia' quality has also been replaced by clean Libre.

Turmeric—Orissa. The object of the scheme is survey and collection at Konni have revealed that the plants are very sensitive to direct rays of the sun. The foliage receiving sunshine for greater part of the day, especially in bigger plants, was badly affected and in many cases dried up. The need for shade plants was thus clearly indicated. The experiments are therefore being shifted to Monar valley which is more sheltered and at a higher elevation.

In nursery practices at Nagercoil dibbling seeds deeper than an inch in the soil reduced their germination percentage markedly. Seedlings raised with watering and heavy shadding were found to be healthier and more vigorous than the others.

Turmeric—Orissa.—The object of the scheme is survey and collection of various types of turmeric and selection of types possessing good yield and quality, agronomic work such as crop rotation, manuring, spacing and finally efficient methods of curing and polishing turmeric. The following results were obtained. Of the various local types tested for high yield Sarangada proved the best. The highest yield of raw turmeric was obtained when a spacing of 9 inch along the row in the case of mother rhizomeplots was adopted. The application of artificial fertilizers such as superphosphate, potash and mangnesium carbonate did not lead to any conclusive results. The application of either ash or potash as manure for turmeric does not appear necessary.

Investigations on the curing of turmeric have yielded some results. Polished turmeric fetches 20 per cent higher permium than unpolished or crudely polished. Recovery of polished turmeric is 94 per cent of the cured and dried turmeric. By the adoption of improved type of furnace used in curing turmeric, 30 per cent fuel economy can be affected. Loss of turmeric due to polishing is 2 per cent of the cured and dried turmeric.

Cardamom—Madras. A survey of cardamom in important growing areas was made. After a study of 3 years, from 120 single plant selections made from Singampatti for high yield and other desirable characters, 22 of them were selected for yield trials.

Investigations on measures to control clump rot (Falling off) disease in cardamoms caused by *Pythium vexans* showed that ammonium phosphate and superphosphate helped to arrest the disease and induce quick recovery of the diseased clumps. The cardamom thrip *Taeniothrips cardamomi* is the worst pest of cardamom, which has spread to all the cardamom growing areas of South India causing heavy damage in yield and quality. Nicotine sulphate as spray and Grammexane as dust proved to be very efficient, economical and superior to all other insecticides tried for the control of this pest. Torch brand D.D.T. emulsion also seems promising. In preventive measures there was found to be no appreciable difference between weeded and non-weeded plots as far as the extent of damage of cardamom pods are concerned.

Coriander—Gwalior. Experiments on the effect o f watering on the incidence of wilt have shown that wilting per cent was more in the case of 3 waterings in the season than in two. The affected roots of almost all the wilted plants had the hyphae of the fungus in their xylum vessels which was identified as *Fusarium*. Among 5 varieties of coriander tried for wilt resistance the local variety showed some promise.

Ginger, Palmyra, Pepper and Chillies—Madras. The four new schemes on Ginger Cultivation, Improvement of Chillies, Research on Plymyra juice and Improvement of Pepper in Madras were put in operation late in the year.

Scheme for the introduction of milk yielding trees—Bombay. The object is to study the possibilities of introducing the vegetable milk as a substitute for cows' milk.

Some seeds were obtained last year from Venezulla through the Indian Embassy at Rio de jeneiro and tried in Kanpur, Bombay and West Bengal, but none of them germinated. Arrangements are being made to obtain fresh cortifurwerts of these seeds.

Fruits

During the year the following eleven Schemes were sanctioned:

(i) *Utilization of growth promoting substances in commercial horticulture, Bihar.* The objects of the scheme are to study the effects of various hormones for promoting root-growth, inducing parthenocarpy (production of seedless fruits) or ploypoidy (duplication of chromosomes), and checking pre-harvest fruit drop. In particular the effect of hormones will be studied on (a) the root formation in cuttings of mango, litchi and other fruits which are difficult to root and (b) the extent of stimulus which may result in the development of seedless papaya of commercial value.

(ii) *Scheme to control pre-harvest fruit drop in apples and citrus by the use of synthetic chemicals, Punjab.* The object is to explore the possibilities of the control of pre-harvest fruit drop in apples, citrus and mango (Langra variety) by the aid of synthetic chemicals, which have been found effective elsewhere.

(iii) *Scheme for the preparation of hormones at the Indian Agricultural Research Institute.* The hormones prepared at the Indian Agricultural Research Institute will be supplied to the Punjab and Bihar centres for trials.

(iv) *Schemes for manurial trials on citrus fruits, Punjab.* This is the revival of the scheme which was terminated on 31 March 1948 due to partition of the country.

(v) *Scheme of research on grape-vine hybridization and citrus root-stocks, Punjab.*

(vi) *Scheme of research on standardization of mango root-stocks, Punjab.*

(vii) *Establishment of Stations for carrying out research on fruits in the plains of Uttar Pradesh.* The object of the scheme is to investigate various aspects of fruit growing, e.g. breeding and evolution of new varieties, improvements in cultural and propagation methods, conservation of soils and soil moisture, methods of storage and fruit preservation, manurial and water requirements, and control of insect-pests and diseases.

(viii) *Horticultural investigations on hill fruits, Chaubattia, Uttar Pradesh.*

(ix) *Mycological and Entomological investigations on hill fruits at Jeolikot, Uttar Pradesh.*

(x) *Scheme of research on the increased production of tomatoes, potatoes and other vegetables by the application of hydroponic methods, flower extracts and growth promoting substances, Banaras Hindu University.*

(xi) *Scheme for starting a training centre in fruit and vegetable* potatoes and other vegetables by the application of hydro- and vegetable preservation both on a cottage and commercial basis to a limited number of students and to start a cottage industry course exclusively for ladies for a duration of three weeks. The Council has sanctioned Rs. 4,800 for a period of one year. The scheme will be located at the Branch Fruit Technological Laboratory, Gauhati.

The following schemes are in progress at present and brief description about each of them is given below:

Fruit Research Scheme, Bihar. The object is to carry out research on commercial fruits in Bihar especially to select the best type of mango, litchi and papaya and also to work out manuring schedule for mango to suit the different tracts of Bihar. As regard mango, the following varieties have been found outstanding from the commercial point of view—Surkh Burma an early variety and an annual bearer, Aman Ibrahimpur, Aman Desheri, Khasulkhas, Husnara and Calcuttia Bombai (mid-season varieties) and Taimuria, Samarbahist of Chausa (late varieties). In case of litchi, china variety has been added to the list of successful varieties, viz. Purbi, Deshi, Bedana

and Dehra Aose. As regards the manurial trials on mangoes it has been found that the application of ammonium sulphate alone or in conjunction with bonemeal during June gave the best results so far as flowering was concerned.

The Fruit Research Scheme, Madras in progress since 1935, is designed to improve the fruit industry of the plains by under-taking research on the more important commercial fruit crops, particularly mango and citrus. Amongst citrus varieties, Hawaiian pummelo continues to bear unusually big sized fruits with a record weight of 8½ lb. In mangoes, for the first time in eleven years of planning, *Mangifera odorata* had given seven fruits while a single fruit was harvested from Langra also, for the first time after nearly twelve years of planting. One tree of Pacharsi variety gave a record yield of 7,152 fruits.

The Scheme for controlling insect pests of fruits and fruit trees in Uttar Pradesh was sanctioned in 1946. The work on some of the serious insect pests such as gall-makers, citrus leaf miner, fruit sucking moths and *anar* butter fly is in progress. The study of life histories and the seasonal histories of these pests have been completed. Eight types of galls were observed on mango leaves, six of which have been found to be caused by cecid flies and two by Psyllids.

The Scheme for establishment of Banana Research Station in Madras was sanctioned with effect from 1 April 1948 and commenced in 1949. Two sub-stations of this scheme have been sanctioned with effect from 1 April 1949 one in West Bengal and the other in Bombay. The object of the scheme is (i) establishment of comprehensive varietal collection area, (ii) hybridization and selection of promising mutants, and (iii) study of propagation practices, packing and transportation methods.

The Mango Necrosis Scheme, Lucknow University aims at finding out the cause of the 'Black tip' disease of the mango fruit and at devising control measures for the same. It has been established that there exists a definite relationship between the occurrence and prevalence of the disease and the presence of the brick-kilns. Simultaneously it has been established that the disease is not due to bacteria or fungi. Ether has been found to be the most solvent of the fume constituents causing the necrosis while the chloroform appears to be the second best. The Scheme has now reached a stage when useful results may be expected.

The object of all the Citrus Research Schemes in operation in Madhya Pradesh, Assam, Orissa and Coorg has been to find out the best varieties, suitable stocks and scions, quick and cheaper methods of propagation and suitable cultural methods. Some important results achieved during the period under report are given below:

Madhya Pradesh

Studies in girth measurement of the Santra trees have been made. The increase in height of Santra trees on various root-stocks was also recorded. The increase in height during the year was a little over one foot in all cases.

[illegible]

Musa paradisiaca are genetically compatible to one another and produce a large number of seeds when the crosses were made among several diploid (2n-22) varieties. Further observations are in progress.

The Scheme for cytogenetics of mango and banana aims at cytogenetical study of mangoes and bananas grown in the Bombay State, Central India, the Madhya Pradesh and the Hyderabad State. The Scheme is in operation since March 1948. Detailed chromosome morphological studies of mango have been carried out. Comparative studies in the idiogram, chromosome—nucleolus relationship and the nature of secondary bivalents in the different species of banana have also been worked out.

Fruit Preservation Training Course for Ladies

The scheme was started in October 1946 with a view to train lady teachers in fruit preservation and canning. The third session of the advanced course started in October 1948 and ended in July 1949. Seven candidates deputed by the various Provincial Governments have been trained during the year. The training course has now been closed down with effect from 31 August 1949 due to financial stringency.

Schemes for the Description of Important Varieties of Fruits Grown in India

This forms the second year's brief report of work done under the scheme for the Description of Important Varieties of Fruits Grown in India since its inception on 8 September 1948.

The following items of work connected with the scheme were attended to during the year under report:

(1) Tours to the different mango growing centres were undertaken during the flowering and fruiting seasons of the mango in May to June 1949 and January to February 1950 respectively to collect either specimen samples of fruits of the different varieties of mango cultivated in different mango growing centres in India for purposes of description or for work connected with the verification of data collected on the vegetative and flower characters of different varieties collected during the flowering season in the previous year.

(2) Complete fruit descriptions of 177 varieties of mango collected during the tours were recorded.

(3) Photcgraphs of 177 mango varieties described were taken and natural size enlargements of these varieties were made for colouring these to natural shades of colour of fruit.

(4) Thirty enlargements of the mango varieties were painted to natural colour shades with the help of the available colour sketches of some of the varieties supplied by the Agricultural Departments of Madras, Bihar and Hyderabad.

(5) Descriptions of the vegetative and flower characters of 130 varieties of mango collected during the flowering season of the previous year were verified.

(6) Descriptions of the vegetative and flower characters of another 18 mango varieties, selected for study during the current year, were recorded.

Scheme for Abstraction of Horticultural Literature

Work under this scheme continued to be done by Shri S. L. Katyal, M.Sc. (Calif.) during the year under report.

Monthly leaflets of 'Horticultural Abstracts' were cyclostyled and sent to the horticultural workers in the country. The list of horticultural workers benefiting by this scheme swelled to 275. The members continued to take keen interest in the abstracts and many queries in this connection were attended to.

About 300 abstracts, summaries, extracts, etc. taken from over 40 journals, various leaflets, circulars, annual reports of the Horticultural Stations in India, and literature published in the foreign countries, were circulated. Instead of mere abstracts, detailed information summarizing the articles published, and the details of the methods used in the experiments, the equipment used, the source of the availability of the material, etc. were fully given in the abstracts so that the information supplied could be fully utilized by the horticultural workers in the country without further references or queries.

Particular attention was paid to the abstraction of literature published in India but at the same time full use was made of the articles and papers published in the foreign countries and considered valuable for Indian conditions. In the latter case, detailed information was provided in the abstracts regarding the methods employed, the results achieved to fully equip the research workers in India, to follow experiments on these lines.

The abstracts were arranged under headings: Tropical fruits; citrus and sub-tropical fruits; Temperate fruits; Storage, Processing and Plant Products; Vegetables and other Crops; Floriculture; Small fruits, vines and nuts; Miscellaneous; and Plant Protection and Diseases.

Broadly speaking, the subjects taken into consideration were Fruits, Vegetables, Preservation of Fruits and Vegetables and Ornamental Horticulture.

Vegetables

During the year the following two Schemes were sanctioned:

(*i*) *Scheme for the improvement of tuber crops, Madras.*

(*ii*) *Scheme for research on tapioca and sweet potato in Travancore-Cochin.*

The object of these two schemes is to evolve improved tapioca and sweet potato strains with high yield, resistant to pests and diseases and capable of being grown in any season of the year.

Six other Schemes of research on tuber crops in Bombay, U. P., Punjab, Bihar, Orissa and Mysore sanctioned last year have started functioning except the U.P. Scheme.

Of the potato schemes the following three schemes were taken over by the Central Potato Research Institute with effect from 1 April 1949.

(i) Potato Breeding Scheme in Northern India, Simla.

(ii) Intermediate Hill Station at Bhowali.

(iii) Potato Seed certification Scheme, Indian Agricultural Research Institute.

The Scheme for control of storage pests and diseases of potatoes, Bihar financed by the Council terminated on 31 March 1950 and the Central Potato Research Institute will undertake the research work on outstanding items. The important results achieved during the year are as follows:

(i) It was found that the incidence of moth attack was more on the middle-sized tubers than on big and small-sized ones.

(ii) It was established that the number of eggs laid was more in light than in darkness or dimlight.

(iii) Coverings of sand and garlic, and sand and chillies, gave best results when applied as protective measures during storage of tubers.

(iv) Tubers treated with D.D.T. and stored on *machan* gave the best results.

(v) So far as different types of floor, from the point of view of fungus rot, is concerned the mud floor gave the best results.

(vi) It was observed that the greater the irrigation, the lower the percentage of infection.

Soil Science

Experiments carried out under the minor and trace elements scheme at the Indian Agricultural Research Institute have revealed further results of practical importance. Work on citrus showed that manganese and zinc defficiency is common in citrus orchards in such widely separated areas as the Punjab, Madras and Coorg. At Indian Agricultural Research Institute (New Delhi) and Karnal (Punjab) investigations on gram diseases (top yellowing, bronzing and bronzing and yellowing) showed that boron defficiency is probably the casual factor. The scheme has been extended for another 3 years.

Investigations carried out under the scheme for nitrogen fixation in soil at the Indian Agricultural Research Institute have shown that the crop of *arhar* does not depend for its nitrogen on the root nodule organisms. This however has to be confirmed by further investigations. In case of inoculation with gram it has proved beneficial at Karnal Sub-Station, and at Coimbatore and the crop gave higher yields. Studies on wild legumes have revealed that some of them may be suitable for green manuring purposes. This scheme has also been extended for another three years.

Experiments on the control of soil erosion at Viswabharti continued during the year. In the 'Run of' experiments *sabai* grass has been found to be a better soil binder than cowpea; the better canopy development of cowpea however arrested erosion more successfully than the *sabai* grass. In trials with quick growing trees in the demonstration nursery, only cashewnut trees responded. Among legumes out of the

18 American varieties tried only perennial *Lespedeza sericea* showed the best results. Indigenous perennial grasses like *munj*, *khus khus*, lemon and *sabai* did well and also checked erosion on the slopes. Eleven acres of eroded ravines were reclaimed by checking erosion and mixed plantations have been done with cashewnuts and *Cassia siamea*. Demonstration on soil conservation methods were given to the neighbouring villages. The scheme will be taken over by the West Bengal Government from April 1951.

The Scheme for the investigation of sewage farming carried out at the Indian Institute of Science, Bangalore has terminated. The investigations have yielded results of considerable scientific interest and practical value. In addition to the results enumerated in the last year's annual report the following further observations made in the scheme are worth mentioning:

(1) Crops particularly the fodder grasses on well drained, porous, sewage soils respond well to sewage irrigation.

(2) Soil irrigated with sewage invariably showed the presence of considerable number of *B. coli* and other lactose fermenters derived from sewage. Even with successive washing of vegetables grown under sewage irrigation the bacteria persisted but when vegetables were cooked or boiled in water for ten minutes the organizms were killed out. In the case of vegetables taken in raw state or subjected to only partial cooking there is a risk of contamination from these organizms. Fodder crops are more suited for sewage irrigation as the pathogenic bacteria from sewage do not seem to affect the cattle.

(3) The dilution of raw sewage by the addition of clear water was found beneficial to its clarification and oxidation; thus promoting the development of aerobic organisms and influencing the progress of nitrification. It also reduced the smell, breeding of flies and sewage sickness.

(4) Laboratory experiments revealed that application of suitable amount of calcium compounds to sewage soils promoted nitrification as well as the availability of phosphorous. Pot culture and field trials confirmed these results and showed that addition of burnt lime in proper dosage produced better growth of plants and higher yields.

(5) The application of a mixture of burnt lime and ferrous sulphate checked to a considerable extent the development of hookworms which were found to develop in large numbers in sewage soils under certain climatic and local conditions.

The scheme on crop production by catalysis at the Indian Institute of Science, Bangalore, has terminated. The investigations carried out have shown that yields of crops could be enhanced by the application of certain chemicals to the soil in a fine state. These chemicals exert a beneficial influence on soil organic matter. Small quantities of iron and manganese salts increase the rate of oxidation of soil humus, thereby releasing larger quantities of plant food to the ultimate benefit of the crop. A new scheme for soil conservation in Himachal Pradesh has been sanctioned during the year. The object of the scheme is to undertake ecological survey, cultivation of soil binders and to find out suitable measures to reduce soil losses and to determine the right texture of soil for the cultivation of different agricultural crops.

Agronomy

The Coordinated Crop Weather Scheme which was granted an extension for a period of one year ending on 31 March 1950 has been taken over by the Government of India with effect from 1 April 1950 as a part of permanent activity of their Meteorological Department. Some of the work done in the scheme during the year is mentioned below:

The problem of drawing up instructions for the estimation of the 'incidence' and the 'intensity' of insect pests and diseases has been engaging attention. With the help of the information collected by the Questionnaire as well as the available experience in 'sampling', two technical circulars, Nos. 51 and 52, have been prepared. The instructions given in these circulars are being tried out in detail at Poona and distributed for trial to the out-stations. After these schedules of observations have been tried out for a few years they will be revised in the light of experience.

The results of the investigations conducted on the sugarcane crop for estimation of yield by sampling showed that the standard error of mean yield ($\sigma s \sqrt{n}$) decreases with increasing sample size. The results of random sampling at different percentages show that the percentage of information increases with increase in sampling level. It is also indicated that about 14 per cent sampling would give a fair estimation of yield.

A new scheme for utilization of bones as fertilisers has been sanctioned at the Indian Agricultural Research Institute this year. The object of the scheme is to find out suitable methods for powdering bones on a cottage industry basis for use as fertilizer and cattle feed, more on a small scale so as to fit in with village economy.

Botany and Cytology

Under the scheme for research on cytology and plant physiology at Almora some interesting results are available.

Mustard. After several trials, suitable technique has been evolved for grafting vernalized seedlings on control seedlings of mustard, T. 102.

Wheat. Vernalization response of 25 new strains of Indian wheat was observed, both at Almora and in New Delhi. The earliness observed in plants from vernalized seeds, in all the 25 new strains, was slight. Experiments of the previous year indicated that by closer spacing, higher yield of wheat can be obtained by the use of vernalized seeds. This year still closer spacing was also tried. The increase in yield was statistically significant. This experiment will be tried again next year.

Barley. Vernalization response of three strains of huskless barley tried last year was observed again this year. The earliness observed in ear emergence of plants from vernalized seeds of huskless purple barley, C.293 was unusual, being 3.87 days, the maximum so far observed for any Indian cereal. The protein contents of grains from vernalized and control plants of several strains of wheat was determined. It was found that the grains from vernalized plants had higher protein contents.

Satisfactory progress was maintained in the Plant Introduction Scheme at the Indian Agricultural Research Institute. 116 samples of cereals, 9 of fibre, 22 of pulses, 78 of vegetables, 14 of medicinal plants, 21 of tuber and root crop, 52 of grasses, 71 of legumes and a number of samples of other plants were secured from foreign countries and tried in a live herbarium and notes made about their characters. A list of plants grown under the scheme was prepared and published.

The scheme for the Investigation of Physiological and Biochemical Changes induced by Pre-sowing Hardening Treatment of Crop Seeds started at the Delhi University on 8 March 1950. The object of the scheme is to find out the water obsorbing capacity of seeds, determination of physical content of proteins, iso-electric points and the determination of enzymic activities which induced response of seeds to pre-sowing hardening treatment.

Another scheme to conduct investigation on the Chemical Stimulation of Ovules at the Delhi University was sanctioned during the year. In recent years due to the experience obtained from experiments done on the application of different hormones and various chemical agents to plant growth, chromosome doubling, etc. it is thought that application of such chemical agents in suitable manner may be effective in inducing the above phenomena to plants.

Entomology and Mycology

Tests with DDT and other allied insecticides were continued at the Indian Agricultural Research Institute, Bombay and the Uttar Pradesh Experiments on this insecticide carried out in Madras have terminated. The investigations carried out there have resulted in considerable information of practical importance for the control of a large number of insect pests. DDT and BHC, even, at as low a strength as 2 per cent were found to control effectively *Caloeoris amgustatus* resulting in increased yield. BHC was, however, found more promising than DDT. The DDT and BHC sprays at 0·1 per cent. concentration effectively controlled the paddy thrips. In the Uttar Pradesh, the yields of rye seed and potato tubers in the DDT treated plots were significantly higher than in the control plots. 2,25 per cent. DDT emulsion at 300 gallons per acre and 5 per cent benzene hexachloride dust at 30 lb. per acre reduced the population of the bug by 94 and 50 per cent respectively. In Bombay, 5 per cent BHC in the form of Hexyclan or Gammexane gave a complete control of paddy grasshoppers 5 per cent DDT—sulpher mixture in proportion 1:1 or 2:1 yielded cent per cent reduction in the population of hoppers .

The scheme for research on stored cereal pests, Punjab has recently been started and necessary steps are being taken by the Punjab Government to start the scheme for research on snythetic insecticides sanctioned last year.

Under the scheme for Cooperative experiments on fungicidal sprays at Indian Agricultural Research Institute, Madras and Mysore sanctioned with the object to determine the usefulness and economics of certain new fungicidal sprays and dusts, e.g. Fermate for the control of plant pests, the requisite chemical was supplied by the Director, Indian Agricultural Research Institute to Madras and Mysore for trials. The Government of

Madras closed the scheme prematurely as it was found that none of the new fungicides was likely to replace Bordeaux mixture for the control of damping off of tobacco seedlings or the control of downy and powdery mildews on grape vine. The report from Mysore is awaited.

The Plant virus scheme at Poona continued during the year. Regular rogueing of diseased *bhendi* plants gave an average yield of 5,904 lb. per acre at the Agricultural College Farm, Poona, as compared to 1,620 lb. per acre harvested in a cultivator's field, where rogueing of diseased *bhendi* plants was not undertaken. Study of the sunn hemp mosaic showed that the virus causing it can withstand dilution of 1 in 100,000 and heating up to 90°C. for 10 minutes. The virus was still infectious after 557 days ageing. In the 'Kette' disease of cardamom, the banana aphis, *Pentalonia nigronervosa* has been found to be the only transmitter and not *Myzus persicae* Sulz and *Aphis helichrysi* K. Investigations into Rogose Mosaic of tomato showed that the viruses of rosette disease of *Cassiators* and leaf-curl of *Euphorbia geniculata* were successfully transmitted by the white-fly to tomato causing typical rosette symptoms in the latter host. It was found that in the mosaic of *Carica papaya* the virus was transmitted by *Aphis medicaginis* and *Aphis jacae* in addition to the four aphids mentioned before. It was also shown that *Myzus persicae* and *Aphis malvae* are the major vectors of the mosaic virus. The investigation on the sterility disease of *Cajanus cajan* showed that it was not transmitted by sap inoculation and that it was believed to be due to the exceptionally dry weather prevailing in Gujrat last year.

Schools of Research in Entomology and Mycology. Schools or research in Entomology in Bombay, Madras, and at Aligarh, Lucknow and Allahabad Universities have terminated. Those at Kanpur, Agra and Indian Agricultural Research Institute, continued. A new school on 'Jassidae' under the Plant Protection Adviser has been sanctioned. The school in Madhya Bharat has not yet been started. The Mycological schools in Madras, Bengal and Punjab have terminated. The School at Indian Agricultural Research Institute continued. Those at other centres have not yet been started.

CHAPTER III.—FRUIT TECHNOLOGY

General

The Institute with its skeleton staff and restricted facilities, due to financial difficulties and its uncertain future continued as here-to-fore, i.e. under the Council.

Decision was taken by the Government in December 1949 to merge this Institute with the Central Food Technological Research Institute, Mysore with effect from 1 March 1950.

Dr G. S. Cheema, Director of the Institute, retired in August 1949 and Dr Girdhari Lal joined as Director of the Institute in the end of August 1949, after expiry of his about four months' leave. Lack of adequate equipment for work in all directions offered considerable difficulties in the conduct of normal work of the Institute. The work carried out up to 28 February 1950 is briefly described below:

Bio-chemical Investigations

Vitamin C concentrates and syrups. Experimental set of *amla* (Emblic-*Phyllanthus emblica*) syrup prepared last year have, in general, shown a satisfactory storage behaviour during the year under report, both in respect of palatability and vitamin C. In general, syrups with 50°, 60°, and 70° Brix sugar concentrations, preserved with 350 p.p.m. SO_2; yielded comparatively the best products during one year's storage study.

Further experiments to obtain syrups with higher vitamin C content were continued during the year. The product prepared is under examination. Complete data on the chemical composition of the fruit and vitamin C losses during processing, have been collected.

Experiments on candies and preserves

Candying of ginger. Preliminary experiments have been carried out for the preparation of a reasonably fibreless candied product out of the ordinary fibry variety of ginger.

Preserves. Methods have been standardized for the preparation of improved quality mango and *petha* (ash gourd—*Benigosa gerefera*) preserves. Experiments undertaken in case of apple preserve are still in progress.

With respect to the methods of packing and storage, pear preserve has been satisfactorily packed and stored for over one year in sanitary plain tin cans while further work in this direction is still needed for packing of *amla*, carrot, apple and *petha* preserves.

Preservation of pure citrus juices. Storage tests on the various sets of different citrus juices packed last year, were continued. Results of further bimonthly examinations have confirmed the last year's findings.

Besides packing in plain tin cans has been found helpful for better retention of both vitamin C and colour when compared to the bottled product. Excessive head-space in the containers, on the other hand, has been found to affect adversely the retention of both vitamin C and colour. The investigation was concluded during the year and the results compiled for publication.

Utilization of shariffa, chikoo, *papaya and* kharbooza

(i) Shariffa (*custard apple*-Annona squamosa). Various *shariffa* products, viz. canned plup, squash and a sweetened blend with orange juice, under storage tests since the last year, showed further deterioration in quality. Further experiments in this direction could not, however, be undertaken due to lack of some essential equipment.

(ii) Chikoo (Sapota acbrassapota). Tentative methods of preparation of canned product and squash from *Sapota* (*chikoo*) have been standardized.

(iii) *Papaya.* Papaya has been analyzed for its composition and successfully used for the preparation of canned slices, jam, *chatney* and dried products; canned slices particularly being of very good quality. Both canned slices and squash have shown good storage behaviour, so far over a period of about 9 months.

(iv) Kharbooza (*musk melon*). This fruit is widely cultivated and sells very cheap during the glut of season. Fruit has been analysed for its chemical composition and tentative recipes have been evolved and methods standardized for the preparation of *kharbooza* squash and canned slices. Both the products particularly the canned slices have shown excellent storage behaviour during a period of about nine months. Further storage tests are being continued. It did not yield good jam.

Deterioration in the colours of fruit products during storage. In this connection, experiments with *jaman* and tomato juices were continued, but no conclusive results can be put forth at this stage.

Tamarind beverages. On the basis of last year's perliminary work, satisfactory recipes have been evolved for the preparation of beverages and sauce from tamarind.

Preservation of cane juice. Pure cane juice preserved by the method evolved last year, has been found to retain its normal refreshing taste and aroma as well as freshness, at least for a period of one year up to which it has so far been tested.

Canned 'curried' vegetables. Such 'ready to serve' type vegetables are in great demand by the Defence Ministry. After exhaustive preliminary experimentation, tentative recipes and general methods for the preparation and packing of seven combinations of different vegetables, in accordance with the R.I.A.S.C. specifications, have been worked out. Five of these combinations were finally packed under different specifications in plain as well as lacquered cans and are now under examination.

Canning of vegetables in brine. Examination of some commercial samples of these vegetables, received from factories, indicated that blackening of tin plate in canned cauliflower was a very common defect. To overcome this defect, seven experimental lots of cauliflower (under different treatments) were packed and are under examination.

Arvi (*collocasia*) *as a food supplement.* At the instance of the Assistant Agricultural Commissioner, Indian Council of Agricultural Research, experiments were undertaken to investigate if *arvi* could, in some suitable form, be used as a supplementary food. In this connection, a method has been standardized for drying of the vegetable and preparation of flour therefrom. The flour has been found quite suitable for mixing with wheat flour, at least in the ratio of 1:3 in the making of *chapatties.*

Guava products. Experiments on canning of guava (an important indigenous fruit) were undertaken with particular reference to avoid discolouration of the product during storage and to standardize minimum requirements of sugar in syrup, times of exhausting, sterilization, etc. The sets thus prepared are under examination. Experiments on guava cheese were also carried out to standardize a method and establish conditions for chemical control during its manufacture, so as to get a standard product of uniform quality.

Preservation of pure orange juice. Preliminary experiments to avoid or minimize off-flavours introduced in orange juice by ordinary methods of processing have been undertaken with very encouraging results. Further experiments are in progress.

Analyses of samples. One hundred and two samples of different kinds of fruit and vegetable products and raw materials, received from various sources, during the year, were analyzed and tested. Complete reports on these were submitted making recommendations wherever necessary for improving the quality.

Microbiological Investigations

Maintenance of pure cultures

The various types of pure cultures of mould, yeast and bacteria in stock were regularly examined and multiplied at the Indian Agricultural Research Institute, Delhi as heretofore.

A number of high acid yielding strains of acetio bactena were isolated for use in the preparation of vinegar.

Fermentation studies

(a) *Alcoholic fermentation.* Two lots of grape juice (from poor quality grapes) were fermented with specific yeast culture for demonstrating to students of the Diploma Course Class, the principles and practice of alcohol production. A number of basal sugary materials were similarly put to this type of fermentation prior to their use in the vinegar generator.

(b) *Acetic fermentation.* Studies on the small scale Laboratory quick vinegar generator were continued and its design (both in construction and material) greatly improved with respect to its capacity and aeration system.

using high acid forming species of acetic bacteria. This improved type of generator was used for fermentation studies for the sugary materials mentioned above.

Complete analysis of about six samples of vinegar prepared in the above manner showed that the laboratory product did not lack in any way (chemical contents, taste, flavour, etc.) when compared with the best quality foreign brands of vinegar available in the market.

Brining and pickling of vegetables

Work on brining and pickling of vegetables was continued during the year on a few more fruits and vegetables, viz. (a) bitter gourd (*Momordica charantia*), (b) raw papaya (*Caprica papaya* L.), (c) *karonda*, (d) *khatta* peels (*Citrus aurantium* L.) and (e) *amla* (*Phyllanthus emblica* L.). The changes in the acidity of the brine, colour, flavour, taste and texture of the vegetables, were determined at regular intervals during the process of curing. The curing process in the case of the above five vegetables was carried out in brines varying from 10 to 20 per cent (common salt) containing varying amounts of ingredients like acetic acid, turareric powder, etc. for a period ranging from 20 days to 2 months. The samples of oil pickles prepared from these vegetables with usual condiments were of very satisfactory quality.

Microbiological investigations on preserves

(a) *Pear preserve*. Preliminary work previously conducted indicated that fermentation in preserves was sometimes due to infection carried by the fruit on its surface. Washing of the fruit with chlorine water, acetic acid, potassium permanganate, sulphur dioxide and formalin indicated that treatment of fruit with 350 p.p.m. sulphur dioxide, gave a preserve which did not spoil uptil 6 months' storage.

(b) Amla *preserve*. A number of lots of *amla* preserve (prepared after treatments with different detergents last year) kept well during storage and showed no signs of fermentation. The control lot indicated heavy alcoholic type of fermentation.

Preparation of Indian type beverages (Kanji)

Experiments on this beverage were further continued to improve the keeping quality of *kanji* obtained from black carrots. Red-coloured carrots, however, did not yield a satisfactory product.

Utilization of stale lime juice cordial

M/S Kissan Products Ltd., Bangalore, sent to the laboratory two dozen bottles of their old stock of lime juice cordial with a view to know a method of conversion of this 'old' product into vinegar. Laboratory trials in this connection are in progress, and the results obtained will be communicated to the firm in due course.

Study of microflora in tamarind cocktail from the biochemical section.

Five lots of tamarind cocktail samples received from the Biochemical Laboratory for microbiological analysis were found infested with varied nature of microflora.

Microbiological analysis of fruit and vegetable products

One hundred and seventeen samples of various fruit and vegetable products, collectively, of various kinds of canned products, squashes, cordials, tomato ketchup, etc. were microbiologically analyzed during the year and reports sent.

Microbiological advice to the factories

On request from M/S. The Midland Fruit and Vegetable Products, Mathura, weekly visits of Research Assistant (Microbiology) were arranged for two months (at the expense of the firm) to collect samples of various products from the factory on the spot as well as to guide the firm in the setting up of a small-scale microbiological laboratory.

Teaching work

Three practicals were arranged for the Diploma Class in the microbiology of wines, vinegar and spiced carrot juice.

Technical Assistance and Advice

Enquiries. During the year under report, 399 enquiries dealing with all aspects of Fruit and Vegetable Preservation Industry were attended to by correspondence. The Industry showed particular interest in knowing the methods of canning vegetables ('curried' and 'inbrine') in order to adopt them to meet the demand of Defence Services in this respect.

Personal visits. On specific request from Messrs Midland Fruit and Vegetable Products (Mathura), the Assistant Advisory Officer was sent 5 times during a period of about 2 months (T.A. being borne by the firm) for setting up new machinery as well as to do experimental work on their products on the spot. Also the factory of M/S Behari Lal and Ghasi Ram, Delhi was visited twice by the Assistant Advisory Officer for advice with particular reference to effecting improvements in the methods of *murrabba* manufacture.

Visitors. Total number of 15 visitors (mostly including prominent manufacturers of fruit and vegetable products) visited the Institute during the year to seek help and advice in various matters concerning the industry with special reference to their specific difficulties.

Exhibitions and publicity. Due to lack of funds no headway could be made in this work. During the year a 'Preservers' 'Day' was arranged at the Institute and local manufacturers invited to visit the Institute to see its various activities. Twenty six manufacturers benefited from this arrangement.

Library and store work. Regular numbers of about 24 periodicals and several technical bulletins and leaflets from the U.S.A. were received in the library. Library and store work were attended by the Assistant Advisory Officer as usual during the year.

TEACHING

The fourth Post-Graduate Diploma Course in Fruit and Vegetable Preservation (session 1949-50) started as late as 10 October 1949 due to a variety of reasons. Twelve students were admitted, but one student unfortunately died before actually joining the class, while two students got Government Service and hence discontinued their studies, leaving nine students on roll.

During the period between 10 October 1949 and 28 February 1950, 82 lectures of 1½ hours' duration (in theory) and 69 practicals of 3 hours' duration were given to the class. The students were given training in analysis of various fruit and vegetable products in addition to the preparation of such products as juices, squashes, jams, jellies and marmalade, canned fruits and vegetables, dried and dehydrated products, etc.

Students remained on autumn recess from 12 December 1949 to 2 January 1950.

By the courtesy of four local factories, students were given training in the commercial manufacture of canned vegetables, tomato ketchup, etc.

The First House Examination of the Diploma Course was conducted in February 1950.

Experimental work

(i) Experiments on the determination of blanching time of vegetables by the peroxidase and catalase methods were concluded and the results published.

(ii) Experiments on vitamin C and storage behaviour of guava squash as compared with orange squash packed and stored under identical conditions were concluded and results obtained have been published.

(iii) Results of the physico-chemical analysis of *jaman* vinegar carried out at different stages of its preparation as well as during its storage were also published. (For publication see Miscellaneous).

MISCELLANEOUS

The Director attended (i) the General and Technical Advisory Committee Meeting of All India Food Preservers' Association held at Patiala in April 1949, (ii) The Executive Committee Meeting of the All-India Food Preservers' Association held in Bombay in November 1949 in connection with the Indian Tariff Board enquiry for Sugar Industry.

A total number of 16 articles, as detailed below were published or submitted for publication during the year under report by the Biochemical and Post-graduate Training Laboratory Staff:

(i) *Indian Farming*—1
(ii) *Indian Journal of Agricultural Science*—1
(iii) *Indian Journal of Horticulture*—4
(iv) *Indian Food Packer*—10

except 2 or 3 articles, which are in press, all have been already published.

CHAPTER IV.—ANIMAL HUSBANDRY

Livestock Breeding

(a) *Cattle breeding*

A Scheme on Livestock Investigation is in progress at Hissar since 29 April 1943. The main object is to find out whether by a process of careful breeding, the two most important economic characters in the Hariana cattle, i.e. 'milk yield' and 'draughtability' can be suitably combined to evolve a 'dual purpose type' which would best serve the economic needs of the country. So far detailed information about the milk performance, viz. milk yield, calving interval, age at first calving, etc. of each and every animal in the original experimental herd has been determined. The progenies are gradually maturing and similar information will be collected in due course, in respect of them. The part of work regarding measuring of 'draughtability' did not progress well and it has been, for the present, deleted from the programme. A complication arose in the herd due to the occurrence of brucellosis. The positive reactors have been segregated to check further disease in the herd. The results obtained so far have been encouraging in that that 50 per cent of the heifers originally taken up for experiment have yielded over 2,000 lb. of milk in a lactation. Experiments are in progress to study the frequency of the oestrum in cattle when they are given different types of feeds.

In an allied scheme which is in progress at Palayakottai (Madras State), the object is to improve the milking qualities of Kangayam cows without impairing the draught qualities of the male, by selective breeding and feeding. The herd is kept under semi-ranch conditions and selected heifers are being handled and are being put to selected bulls. Definite results are expected when sufficient daughters mature to enable a proper dam-daughter comparison under uniform enviromental conditions of both work and milk capacity. The results in this scheme have been affected by the continued failure of seasonal rains, want of proper grazing, scarcity of fodder and non-availability of concentrates for feeding the animals regularly. When, however, a comparison is made of the herds in the scheme and of other animals maintained in the Pattagar's Farm, it is gratifying to note that over 60 per cent of the animals in the experimental herd have produced milk over 2,000 lb. in a lactation, while in the case of the other animals of Pattagar the percentage of such high yielding cows was less than 25 per cent. The udder massage practised has given longer lactation period and also higher yields.

It is anticipated that these schemes will produce valuable results to prove conclusively that dual purpose animals can be evolved out of what are hitherto considered as draught breeds.

The village cattle improvement schemes (Bombay and Uttar Pradesh) served as incentives to cattle breeders to breed their stock from approved bulls and to manage and feed their animals on scientific lines. The progeny of approved bulls always fetched a premium. The Bombay Scheme was terminated on 31 March 1949 as a part of the Council's activity. The Indian Council of Agricultural Research has now sanctioned co-ordinated Pilot Key Village Schemes for improvement of cattle in Travancore-Cochin, Uttar Pradesh, Delhi, Orissa, Saurashtra, Hyderabad and

Gujerat. The first three will be initiated this year and the remaining at the rate of two in subsequent years. The Cattle Improvement Schemes at Uttar Pradesh and Travancore-Cochin are accordingly being expanded and revised on these new lines.

With a view to investigating the possibilities of using milking cows for work, on the analogy of the prevailing practice in Egypt, schemes were started during the year at the Indian Dairy Research Institute on Sindhi cows and in Mysore on Hallikar cows. Preliminary results have shown that Sindhi cows are able to withstand light farm work without any effect on the milk yield. Another scheme has been initiated at Patiala to study the influence of marketing and insurance on cattle improvement in the villages. A fair start has been made in six villages. One hundred and thirty five she-buffaloes have been distributed on *taccavi* loans, which is being repaid in the price of milk together with insurance premium to offset losses.

The Council is to finance the Government of India's Artificial Insemination Centre at Bangalore until such time as the regional plan for the setting up of artificial insemination centres in the country is finalised.

The Central Herd Book Section continued to do useful work in connection with the registration of recognized breeds of cattle in the Herd Books maintained by the Council. The total number of animals registered on 31 March 1949 is 5844 as against 5524 in the previous year.

Information regarding Indian breeds of cattle was furnished to Food and Agricultural Organization for incorporation in their catalogue of World Breeds of Cattle. The FAO held a conference on Livestock Breeding in tropical and sub-tropical countries, at Lucknow in February 1950. The Council assisted in the preparation of a 'Brief review of the progress and present position regarding the productivity of livestock in India', which was presented at the Conference on behalf of this country. The Council was further represented at this Conference by its Vice-Chairman and the Animal Husbandry Commissioner. S. Dattar Singh, Vice-Chairman, Indian Council of Agricultural Research, who headed the Indian delegation, was elected Chairman of the FAO Conference. The problems of all these countries under tropical and sub-tropical conditions, in so far as they affected livestock position, were thoroughly discussed and measures were recommended for adoption for the solution of various problems connected therewith. The countries represented at this Conference were, Australia, Belgium, Burma, Ceylon, Egypt, France, India, Indonesia, Iran, Italy, Pakistan, Thailand and United Kingdom.

Sheep breeding

The Indigenous Sheep Breeding and Wool Analysis Laboratory Scheme at Hissar (Punjab) was further extended up to 30 September 1951, which has for its object the evolution of a fine woolly type sheep from the existing flock by selective breeding and to study the maintenance of the flock on economical basis. The flock has been classified into four groups—A, B, C, and D according to their wool utility value in the trade for clothing, carpet, poor carpet, and hairy types respectively. By the introduction of A group rams, group C and D are being gradually eliminated and thus

better quality woolly flocks are being evolved. Animals in C and D groups are being regularly culled; also there was an increase from 31:8 to 43:8 per cent in the number of sheep in groups A and B, whereas there was decrease from 5:6 to 21:04 per cent, amongst the groups C and D. Regular analysis of wool at the laboratory proved very helpful. There was however a set back in this scheme due to disease factors. Encephalomyilitis was responsible for 48 deaths out of 100. Thirteen rams were subjected to female progeny test to gauge the transmitting qualities for wool. Night grazing during scarcity period did not yield any appreciable gain.

Under another scheme improved farm-bred Bikaneri sheep were tried under village conditions in the Punjab, side by side with the village sheep both in irrigated and *baraani* tracts. All round superiority of the farm-bred stock over village-bred stock was not well maintained this year due to disease that adversely affected the farm-bred flocks, although more profit could be obtained by maintaining farm-bred stock. This scheme terminated on 31 March 1949.

Kashmir Sheep Breeding Scheme, Banihal. The ultimate aim of the Kashmir Sheep Breeding Scheme at Banihal is to evolve a Kashmir Merino by cross breeding. So far ¾ and 7/8 merinos have been evolved and the stage has been reached to fix the characters of a Kashmir Merino which may breed true to type. Thus the research aim has been almost achieved and the work only now remains of a development nature. The experiments carried out so far have indicated that the effect of the introduction of Merino blood has been to decrease the staple length of the indigenous fibre. The introduction of Merino strain definitely improves the fineness of indigenous wool but as some of the Kashmir wools are of a very superior order, the improvement in some cases is however not very pronounced. It can be stated that there is a definite improvement in the fineness of indigenous wools by the introduction of Merino strain and in a large percentage of ¾ bred progeny, the wools almost attain the Merino standard. The introduction of Merino blood, as a rule, eliminates medullation and introduces crimp, and also increases shrinkage.

Sheep Breeding Scheme, Bombay. Arrangements have been made to import Rambouillet stock from America by the Bombay Government for purposes of cross breeding. Experience has shown that Merinos present no difficulties in management, except that they suffer more from parasitic infestations than indigenous breeds. The back-crossing of Deccani sheep with selected F_1 and F_2 rams was done. The resultant progeny appears to have great possibilities as it retains the 'hardiness' character of the Deccani sheep but at the same time are a better-fleeced sheep. The yield is nearly three times the clip of the original Deccan sheep. The brown and pink coloured eyes in the back crosses indicate hardiness while those with no colour in the eyes indicated weak constitution. Parasitic infestations were kept in check by using copper sulphate, tobacco and phenothiazine. Sulphamezathine proved efficacious for the control of coccidiosis. Wool Analysis Laboratory under Bombay Sheep Breeding Scheme could not undertake any new problems as the laboratory assistants incharge of the research programme were out on deputation and secondly the laboratory had to be shifted to the farm where neither electricity nor soft water was available.

Sheep Breeding Scheme, Madras. In the Madras Sheep Breeding Scheme whose object is to evolve a white woolly sheep by grading Bellary ewes with Bikaneri rams, the colour of the progeny in the third generation has progressively turned into white. Also the yield and the quality of wool has improved gradually in the succeeding generations.

Sheep Breeding Scheme, Orissa. Its aim is to improve the indigenous sheep by crossing with the Bikaneri rams. The results have shown a definite improvement in the colour and length of wool. Breeding results are indicative of colour prepotency in favour of Bikaneri rams. After effects of castration result in increased body weight. This scheme has terminated.

Bombay University Wool Analysis Laboratory. The laboratory is carrying valuable work of much economic importance in evaluating the potentialities of Indian sheep. 603 wool samples were analyzed from various trade sources and Experimental Breeding Stations. Wool samples from Gwaldam (U.P. Hills) were of a good quality and compared favourably with the Bikaneri wool. The Merino cross wools from Kashmir showed that the more the Merino blood the better the wool quality and that the ewe wool was superior to that of the ram. A special officer, for the collection of trade samples of wool, was employed during the year, who collected 800 representative samples from various trade sources, with a view to their analysis and fixing standards of India wools meant for export.

Goat breeding

Goat Breeding, Punjab. The object is to establish by systematic breeding a pure flock of Beetal breed of goats and to increase their milk supply. There was an unusually heavy mortality in the flock due to an outbreak of encephalomyelitis. This has caused a set back to the scheme. Fortunately, however, still sufficient number of adult goats are available and the work on the scheme is being continued. The average milk yield per lactation and the lactation period rose to 322 lb. and 164 days as compared to 304 lb. and 147 days respectively in the previous year. Goats that had kidded in summer showed better performance than those that kidded in winter.

Goat Breeding Scheme, Orissa. The main object is to evolve two superior breeds of goats, one for South and the other for North Orissa, with increased milk yielding qualities by grading the South Orissa goats with Beetal of Punjab and the North Orissa goats with pure Black Bengal type. Data collected showed that male kids weighed more than female, singles weighed more than twins and twins more than triplets. Two F1 daughters were compared to their dams. The daughters yielded over $2\frac{1}{2}$ times more milk than the dam. In weight and other measurements the male and the females did not show much difference.

Angora Goat Breeding, Punjab. There has been successive decrease in size from first to third cross. The yield of Mohair was, however, higher in the third cross as compared to the hill goat. It was 4.25 lb. in third cross as compared to 1·12 lb. in the original hill goat. Greater length, fineness and absence of medullation was observed in the third generation. To see whether reduction in size was due to climatic factors, shifting of flock to hilly tracts was suggested. As no such suitable area was possible in the Punjab, the flock has been shifted to Uttar Pradesh Hills and the scheme transferred to Uttar Pradesh Government.

Poultry breeding

Village Extension Scheme, Indian Veterinary Research Institute. Though poultry keeping may be more difficult in hot climates than in temperate zones, sufficient data is at present available to show that poultry can be kept even under the most adverse climatic conditions; except that they should be fed and properly housed to give satisfactory returns. Losses due to attacks from wild animals and birds were all too common and 50 per cent of the layers distributed were lost due to preventable causes. Routine vaccination of birds against the common contagious diseases, Ranikhet disease and fowl pox, is essential for successful poultry keeping in villages. The high rate of production of the improved breeds was not obtained in the villages except when the birds were adequately fed. White Leghorns were found unsuitable on the hills while Rhode Island Reds thrived well there. It appeared that better feeding was of major importance, and proper housing was of a secondary importance. The crosses gave somewhat better returns than the pure-breds. As the losses amongst chickens were mainly due to attacks by predatory animals, it is found that it would pay to keep the chicks confined from 0—8 weeks of age. Incidentally the feeding cost at this age is also not higher. From a purely developmental aspect, it is not considered advisable to provide expensive housing but it is possible to devise cheap improved houses from purely village materials such as *kutcha* bricks, bamboos and *arhar* sticks.

A scheme for studying the influence of climate on the performance of the improved Desi (indigenous) fowl evolved as a result of selective breeding at the Poultry Research Section, Indian Veterinary Research Institute, has been sanctioned and will be initiated in suitable area in Madhya Pradesh and Orissa. A similar scheme for studying the performance of pure-bred fowl and grading up the local stock has been sanctioned for Travancore-Cochin and this will give data as to whether pure-bred fowl can thrive in heavy rainfall area. Grading up of indigenous stock will also be pursued.

Under the Madhya Pradesh Poultry Development Research Scheme data on the number and size of eggs produced by the Desi hens and their successive generation *vis-a-vis* crosses of White Leghorn and Rhode Island Red, both under well managed farm and ordinary village conditions, were collected and compared. Fertility, hatchability, longevity and disease resistance under farm conditions were also studied. There was no difference in egg production from representative samples of hens obtained by hatching eggs collected from different regions where the centres are now located in the State. The limited data that has so far been collected are indicative of Rhode Island crosses eventually performing better than the Desi and White Leghorn crosses, in respect of factors so far studied. Considerable progress has been made in contacting the villagers, educating them in better methods of poultry husbandry, improving the number and size of eggs produced by their graded hens, and finally retaining these in market at rates bringing better return to the villagers.

Duck breeding

In pursuance of a previous recommendation of the Animal Husbandry Wing a scheme for research into duck breeding has been sanctioned in Bihar. It is proposed to study the rearing of good ducks, feeding them with rations other than cereals and also problems relating to the removal of smell from eggs of ducks.

Keeping quality of market milk in relation to different treatments. A pilot milk processing-cum-holding plant was designed at the Indian Dairy Research Institute to carry out large scale trials on the intermittent heat-treatment of raw milk under varying time-temperature combinations. A series of trials carried out in this pilot plant proved the efficacy of the method evolved in the laboratory to ensure a minimum marketable life of over 24 hours for milk produced under village conditions in different seasons of the year. Eventually a milk processing-cum-transport vehicle for the transport of milk over long distances was designed.

After a preliminary survey of the rural conditions for collecting village produced milk for large scale field experiments, the Salem City Co-operative Milk Supply Union Ltd., and its feeder society at Tharamangalam village were selected for field experiments. The Livestock Research Station, Hosur, was also chosen as another collecting centre. In the forward journey the milk collected at Hosur was cold-processed and then transported to Salem, a distance of 115 miles and on the return journey from Salem the village milk was collected and double-heat processed at an interval of 8 hours and transported over a distance of 150 miles to Bangalore.

The observations made so far show that (i) the double-heating method can be successfully used to preserve the marketable quality of milk for over 24 hours and also enable its transport from a distance of 150 miles, (ii) the use of cold-process under actual field conditions is much more limited than double-heat processing and (iii) that during the period March—April—May contamination of milk through the entrance of dust is difficult to prevent.

In order to collect information regarding the bacteriological quality of market milk produced and handled under different conditions, such as climatic, seasonal, and of transport and the sources of contamination, viz. utensils used, etc. a scheme was started at Bangalore and Lucknow centres in 1947-48. The milk samples collected from different sources representing an organized dairy farm, village-produced milk and other minor sources of milk supply to urban consumers were tested for plate-counts, methylene blue reduction time, one hour resazurin reduction and presumptive coliform test. During 1948-49, 516 samples representing the monsoon season were collected and analyzed at the Bangalore Centre. The quality of milk supplied by town *gowallas* and that secured by milking the animals at the premises, was generally similar to that of village produced milk. High bacterial counts were encountered in most of the samples and are probably due to the influence of monsoon conditions. The quality of milk produced even in an organized dairy farm during this season was of a poor standard. In most of the samples the species of bacteria commonly associated with feeding stuffs, constituted the predominant flora.

At the Lucknow Centre some 900 samples of milk, obtained from different sources, during the three seasons, viz. winter, summer, and monsoon, were analyzed. The total bacterial counts of milk samples, produced on an organized dairy farm varied greatly from season to season at the time of delivery to the consumers, the maximum being during the monsoon. The incidence of coliforms was exceptionally high in many of the samples, most probably as a result of employing imperfectly sterilized utensils.

The samples of milk collected from other sources revealed a much worse bacteriological picture. They were also highly adulterated with water. Some of the methods of handling and transporting milk adopted by the milk vendors were found to be most objectionable.

The significance of the above findings and the reasonable standards of quality that could be recommended as tentative targets for improving the quality of market milk, under such diverse conditions as those obtainable at Lucknow and Bangalore, can be assessed only after the results of statistical analysis of the entire data are available.

Quality improvement

The scheme for the quality improvement in milk and milk products and their costing continued during the year at the Agricultural Institute, Allahabad, and their various aspects, such as cost of improving the quality of milk and milk products, the extent to which it can be achieved both efficiently and economically, construction and designing of dairy equipment and cost of controlling more common deterioration in milk were further studied.

Ghee. A scheme of research submitted by the Indian Institute of Science, Bangalore, on the glyceride structure of *ghee* from oil cake or seed fed buffalo in order to determine its variation with normal and comparison against adulterated *ghee* has been sanctioned with effect from 1 April 1950.

With a view to standardizing physical and chemical factors arising out of the conditions of manufacture of *ghee* deciding its grain structure and aroma, and gathering further knowledge regarding the handling of raw material, the technique of manufacture and conditions of packing and storage to improve the market quality of *ghee*, a scheme was commenced from 3 January 1949 at the Indian Dairy Research Institute. Only preliminary results are available so far. Butter has been produced by indigenous method under different conditions and from different species of the animals and one set of experiments concluded. The tentative results show that (a) *ghee* prepared from fresh and stored butter obtained from processed milk keep better than that from butter obtained from unprocessed or morning processed and evening raw cow's milk; (b) *ghee* obtained by decantation and subsequent heating keeps better than that obtained by direct heat treatment; (c) the vitamin A value of *ghee* from cow's milk is not affected by storage of butter up to ten days whatever the storage medium may be, while those of *ghee* from buffalo's and mixed milk are affected by storage of butter before clarification. Further experiments are in progress.

A scheme for the development of *ghee* industry which had been running for the past six years at Jhallar in Madhya Pradesh came to a close on 31 March 1949. The good results obtained by the working of this scheme induced the Madhya Pradesh Government to launch a big scheme of their own, which contemplated establishment of 50 such *ghee* centres. Some have already been established and are reported to be running very successfully. It is hoped that a federation of the *ghee* association, when formed, will help a good deal in controlling the *ghee* prices and will have the moral effect in checking adulteration. It will at the same time deliver pure *ghee* at comparably cheap rates to the public and will give more returns to the producers.

Cheese. Under a scheme to further purify the vegetable rennet (obtained from *Withania coagulans*) from substances responsible for its bitterness, and so concentrate the enzyme that it can be used for making cheese, it was found that the aqueous extract of the vegetable rennet from the pulp of the *Withania coagulans* berries contains, besides the active enzymes, a large amount of insoluable matter. To obtain a clear extract reasonably free from this inactive material, trials were carried out with different agencies to remove the material before precipitation. The following method which gave reasonable degree of clarification and at the same time was quite rapid was finally standardized. About 1000 gm. of berries after breaking with hand were soaked in 2500 ml. of water for two days. The mixture was then allowed to drain through fine cloth. Only slight pressure was applied with hand. The extract was then passed through a cream separator. Very active enzyme preparation was obtained by precipitating either with 1·5 volumes of acetone or alcohol, or with HCL at *p*H 4·0.

These preparations gave soft cheese of very good quality. With hard cheese bitterness was noticeable which tends to diminish to some extent on ripening over longer intervals.

Animal Nutrition

Vanaspati. At the Indian Veterinary Research Institute under the scheme to determine the nutritive value of vanaspati and vitamin A content of *ghee*, the following fats and oils were studied for their growth promoting value in the IV generation of rats: (1) Cow *ghee*, (2) groundnut oil, raw and refined, (3) *mohua* oil, raw and refined, (4) coconut oil, raw and refined (5) mustard oil, raw and refined, (6) Dalda. It was found that cow *ghee* was definitely superior to all other fats and oils tested, both in the II and IV generations of rats and that there was no great difference between the vanaspati Dalda (hydrogenated ground-nut oil) and the other vegetable oils. From the carotene absorption and liver reserve of vitamin A experiments, it was observed that the efficiency of utilization of vitamin A was highest in cow *ghee* and lowest in Dalda. It was also observed that there was no marked correlation between the percentage digestibility of carotene and the liver reserve of vitamin A. The requirements of vitamin A when the fat ingested was vanaspati was higher than when it was cow *ghee*, while with vegetable oils, the requirements seem to be intermediate, being higher than with cow *ghee* and low with Dalda. The digestibility coefficients for the different oils and fats ranged from 94·6 per cent to 98·9 per cent which indicate that these fats are absorbed nearly completely and that there were no material differences between the digestibilities of cow *ghee*, vegetable oils or vanaspati (Dalda). These results are not conclusive and a final report on the scheme is still awaited.

Indigenous grasses. A scheme is in force since August 1944 at the Indian Veterinary Research Institute with the object of determining the nutritive value of certain indigenous grasses at the flowering stage and of certain leafy fodders, at a stage when they are mostly required to be fed to livestock. During the year, chemical composition of three grasses, viz. (1) *sein* (*Sehima nervosum*), (2) *guner* (*Andropogon pumilas*) and (3) *Imperata cylindrica* collected at three different stages of growth according to progressive maturity, was estimated. The August cut of these grasses was considered quite good for feeding purposes. In addition the nutritive value of (1) *neem* leaves (*Azadirchta indica*), (2) *shisham* leaves (*Dalbergia*

sissoo), and (3) *gular* leaves (*Ficus glomerata*) was also determined. Preliminary experiments on the palatability and the consumption of *neem* leaves by Kumauni bullocks, buffaloes, and sheep indicated that the animals did not relish the leaves. *Neem* leaves when fed in combination with wheat *bhoosa* and rape cake, however, form a satisfactory maintenance ration. The animals under *shisham* feeding could not consume the whole quantity of dry matter that was being fed in the ration and thus displayed negative nitrogen balance although their calcium and phosphorus balances were positive. Under *gular* feeding, the goats maintained steady weights and satisfactory healthy condition throughout the experimental period and recorded positive nitrogen and mineral balances. This goes to prove that *gular* leaves when fed alone, provide a maintenance ration for goats and also satisfy all the mineral requirements and the necessary food factors.

The digestible crude protein values of all the above three leafy fodders compare favourably with those of *dub* hay, *pipal* and *pakar* leaves. In energy value also they are quite satisfactory to form a good quality roughage.

Fodder. Under the Assam Cattle Nutrition Scheme semiaquatic grasses *arali* (*Leersiahexandra*) a leafy fodder resembling a pasture grass and *nal* (*Arundo donax* Linn.) a tall grass of 8 to 19 feet height and a prolific yielder were studied for their value as green fodder and hay. It was noted that *arali* was a good maintenance ration and that day made from it was comparable to *anjan* or *jowar* hay and it was good for winter feeding. The harvesting time was October and November, when the cultivators were practically free. *Nal* (*Arundo donax* Linn.) grass is not relished in green stage. Its consumption in the form of hay was low and it was not found to give profitable returns. Of the hill grasses *dhus* was studied. It grows 15 feet high in a large hill area as a prolific yielder. Even in December it was found to remain fairly green. Only the top four feet were utilized for experimental feeding and possibly it could replace Napier grass. Experiments are still in progress. As indigenous grasses are generally poor in calcium and feeding mineral mixtures to overcome this deficiency, is not practicable in village condition, two green forages (i) *Kanasimalu*, and (ii) cow pea, that are rich in calcium are being tried as calcium supplements. About 10 grams of either is helpful to give positive balance. Experiments are still in progress. By measuring the amounts of dry faeces voided by cattle it is possible to predict the quantity of grass eaten. By feeding goats on *pakari*, *kethal* and *eimaru* tree leaves, it is found that these leaves are digested to all appreciable extent and the last named was found especially good. It contained the highest digestible proteins so far on record. This scheme has been taken over by the Assam Government with effect from 1 April 1949 as their own activity.

In Orissa a scheme was in progress to work out the economics of balanced rations computed from food stuffs available locally. This is being tried for cattle kept under village conditions in reference to (i) milk yield, (ii) capacity for draught, and (iii) growth. Feeding experiments were conducted in one centre, i.e. Angul (plains tract) in the district of Dhenkanal on indigenous cattle of all categories, i.e. young growing animals, milch cows and working bullocks.

It has been found that the feeding of animals (cattle) with balanced rations can profoundly improve their productive capacity. Further the supply of properly balanced ration is essential not only for the normal

health, growth, efficient work, regular breeding and prevention of nutritional disorders, but it also increases the resistance against bacterial, virus and parasitic infections. Though the results obtained at this centre were highly encouraging, a comprehensive study of the problem of the feeding experiments remains to be made at the different parts of the State before coming to final conclusion.

At the Indian Veterinary Research Institute, a new scheme has been sanctioned to find out the influence of trace elements on the health of Indian farm stocks. To start with the investigations will be confined to a survey of the most likely areas where mineral deficiencies might be suspected, such as heavy rainfall areas and hilly tracts, in order to assess the actual extent of deficiency of these trace elements.

Disease Control

A uniform and steady progress was maintained in the Disease Investigation Schemes for cattle, sheep and goats and poultry working in the various States with grants-in-aid from this Council. The progress reports of those schemes including those which were taken over by the States were scrutinized and their technical programmes co-ordinated by the Animal Diseases and Pests Committee of the Council. A new Disease Investigation Scheme was sanctioned for the State of Travancore-Cochin, the Council contributing one half of the expenditure, viz. Rs. 11,000 for a period of 3 years, while a further extension for 4 years was approved for Kashmir Scheme. Similarly sheep and goat disease investigation scheme for Punjab, Madras, Bihar and Orissa and Mysore were given extension.

With the end of this year, like the Disease Investigation Officer Schemes all the Assistant Disease Investigation Officer (Poultry) Schemes in the States were provincialised, except in the case of Mysore, which was granted an extension for one more year as a special case. It is hoped that with a view to effecting co-ordination so as to prevent overlapping of the work, the technical programmes and the annual reports of all these disease investigation schemes, cattle as well as poultry, will continue to be considered by the expert committees of the Indian Council of Agricultural Research. A new scheme was sanctioned for the investigation of mastitis in Bombay and Mysore.

Diseases of cattle and sheep

Rinderpest. This disease was investigated in Madhya Pradesh, Uttar Pradesh, West Bengal and Kashmir. The viability of the different vaccines in use was tested and the duration of the immunity conferred by these vaccines under different conditions was determined. In Madhya Pradesh no reaction was observed in 66 calves of 9 to 18 months of age when vaccinated by scarification method. On test with hill bull virus the immunity was found to be solid in five calves vaccinated a year back by scarification method. The viability tests revealed that the virus in tissue vaccine remained viable for 6 to 7 days in summer when ampules containing this are stored in water saturated sand. Under similar storage conditions in winter it remained viable for 7 to 9 days. Under prevailing conditions of climate in Madhya Pradesh, during summer packing of goat tissue vaccine in ice and saw dust has not been found to be satisfactory. For summer the most satisfactory method for despatch was in a thermos flask containing ice.

In Uttar Pradesh viability tests of desiccated vaccine stored for 5, 10 and 15 days at room temperature (October and November) and incubator

(43·5-44°C.) were made on buffalo calves. The results were inconclusive as no reaction followed this or to the subsequent challange dose of virulent rinderpest virus. For the immunization of sheep which are usually highly susceptible an anti-serum dose of 20 c.c. with goats was found satisfactory.

In Kashmir, cattle and sheep were successfully vaccinated with goats and though cattle gave a mild reaction, sheep had a more marked reaction. The tissue virus was found to remain viable for 27 days in ice and in 50 per cent glycerine in normal saline solution for 13 days.

In West Bengal it was observed that with the increase in the age of the vaccine brew from 1 to 9 days the percentage reaction declined from 69 to 32. This decline was, however, not gradual but variable. The reaction varied between 20 to 40 per cent showing a tendency to rise during April to June and fall during December to January. In five affected animals of rinderpest the lesions of the cutaneous eruptions were observed after 5 to 6 days of the onset of the disease. But subcutaneous inoculation of such scab emulsion in susceptible calves resulted in no reaction except rise in temperature.

Foot and Mouth Disease. The Foot and Mouth disease scheme continued to function at the Indian Veterinary Research Institute. During the year under report 4 more specimens of Foot and Mouth disease material were typed by cross immunity in guinea pigs. Out of 52 Indian field strains so far isolated from natural outbreaks in the various parts of the country, 18 are Vallee 'O' 15 'O' variant, 3 Vallee 'A', 8 'A' variant, 2 Waldmann 'C', 5 'C' variant and 1 atypical. The atypical strain which was isolated in natural outbreak in 1944 in the Punjab was still found to break immunity against all the 3 standard strains.

Two brews of polyvalent crystal violet vaccine were prepared and were tested in hill bulls, cattle, sheep and goats. None of the vaccinated animals manifested any untoward symptoms except for a couple of hill bulls which developed a slight persistant swelling. A brew of polyvalent gel vaccine was also prepared and tested on six bulls. Eighteen hill bulls vaccinated with crystal violet polyvalent vaccine were tested for immunity after one year against all the three strains. Seventeen bulls out of these resisted the infection. Similarly two other hill bulls and 4 sheep which were vaccinated 25 months back, were found to leave solid immunity. Polyvalent anti-Foot and Mouth disease serum inoculated in incontact animals protected them satisfactorily. An indigenous drug that was tried as a curative was found to be unsatisfactory.

A study of the growth of the Foot and Mouth disease virus on the chorioallantoic membrane of the developing hen's egg was undertaken. The virus was used in the form of one per cent. per epithilial emulsion; but the virus could not be demonstrated to survive on the membrane.

Haemorrhagic Septicaemia. It was investigated in Uttar Pradesh only. The disease was confirmed microscopically at several places including four organised farms. Two of these herds had already been vaccinated with 'agar wash' vaccine (S. O. 5) and the third with ordinary broth vaccine one to two months earlier. Thus these two types of vaccines produced in that State had doubtful values as an immunising agent.

Contagious Abortion (*Brucellosis*). Brucellosis was investigated in Uttar Pradesh, Madhya Pradesh, Orissa, Assam, Madras, Bombay, Baroda, Punjab and Kashmir. In Madhya Pradesh a survey of 13

districts was conducted and the infection has been found to be more or less ubiquitous in that State. However, the incidence has been reported to be lower from the western parts of the State adjoining Bombay State and Berar. This is attributed to low rainfall and hot and dry climate. In Orissa as a result of rigid segregation of the reactors the number of abortions in a dairy has been reduced.

Testing of cattle against this disease was undertaken in almost all the States mentioned above. In Madhya Pradesh out of 1024 animals 201 gave positive and 77 doubtful reactions on 'quick agglutination' test. In Assam out of 8 cows of the Government Farm 3 were found positive on tube test. In Madras 195 samples of sera out of 1024 were found positive. The affected villages contained 15 to 20 per cent abortions, 5 to 10 per cent non-conceptions and 3 to 5 per cent synovitis (both cows and bullocks). In Bombay 40 per cent of samples of serums from infected farms were found positive on agglutination test. Forty eight per cent animals tested in Uttar Pradesh gave positive reaction.

In Assam 22 animals were vaccinated with bovine abortion vaccine from Mukteswar. Reaction observed was local swelling which subsided in 2 to 3 weeks. There was slight rise in temperature also but no drop in the milk yield. In Madras vaccination proved to be successful among animals vaccinated in the previous year. In Bombay 311 heifers were vaccinated under calfhood vaccination experiment. Out of 254 heifers vaccinated in the previous year, 28 calved normally.

Tuberculosis. The Council's scheme for the investigation of T.B. and Johne's disease in animals continued to function. Under this scheme about 19,900 doses of concentrated synthetic medium tuberculin were prepared for research and survey work. 100 samples of milk from various sources in the city of Madras were found to be negative for T. B. bacilli on biological test. Foremilk and strips from 45 reactor cows from a military farm were found to be negative on biological test. Out of the 44 sputum samples tested so far from human patients none has shown any type of bacilli other than human type.

Tuberculin testing of animals was undertaken in this scheme at Madras, Bombay, Baroda, Uttar Pradesh, Kashmir and Bengal. The incidence was found to be as follows:

Place	Number of animals tested	Number positive	Number of suspicious reactors
Ahmedabad (I.V.R.I.Scheme)	(Cattle 3,773 (Buffaloes) 21407	446 3819	..
Madras	39	ö	4
Bombay	39	5	..
Baroda	610	52	12
Uttar Pradesh	268 167	11+2* 16+4*	8+1* 1
Kashmir	152	7	..
West Bengal	55	..	..
Orissa	1	..	..

*Reacted for Johne's Disease.

Systematic testing of sheep and goats at the Indian Veterinary Research Institute, Mukteswar revealed that the Johne's disease had a fairly high incidence amongst them. Among sheep there were 4·6 per cent positive and 5·2 per cent doubtful reactors and among goats there were 28·7 per cent reactors. About 70 per cent of these reactors showed left caudal fold. Two were found positive.

Two hundred and forty goats of Hissar Farm were tested by injecting a single dose of 0·1 c.c. of concentrated tuberculin intradermally at the left candal fold. Two were found positive.

Surra. This disease was encountered in Orissa, Bombay, Assam and Uttar Pradesh. It is reported to be endemic in Orissa. It was prevalent between August to November. Formal gel and mercuric chloride tests when applied to the serum of positive reactors gave variable results, and it was concluded that these tests are not fairly reliable for application in the field for detection of latent surra in bovines. In Assam the disease occurred in 6 districts and as in other States Antrypol gave satisfactory results as curative. An effort to find out the correlation between the reduction in the incidence of Surra and malaria in Assam due to anti-malarial operations was made. The results point out the decline to be due to D.D.T. spray operation. In Bombay during the course of investigation of undiagnosed disease 92 samples of bovine sera were submitted to Compliment Fixation Test; 39 were positive to the test.

Nasal Schistosomiasis. Its incidence is reported to be very high in the heavy rainfall areas of Bombay. It is particularly prevalant in the villages with large tanks which abound with infective species of snails. Treatment of affected animals with Anthiomaline and adding copper sulphate in tanks and river beds gave satisfactory results. In West Bengal this disease occurred almost throughout the State. Different types of soils were found to have no relationship with the incidence of the disease. Incidence was generally higher in winter (November to January), 0·7 to 60 per cent animals were affected in different localities. Out of 186 samples of nasal discharge 175 showed presence of Schistosome ova. It was observed that the ova of schistosomes were also present in 80 per cent normal cattle and buffaloes in the affected areas. These were also present in nasal discharge of goats though they do not suffer from the disease.

Bovine contagious pleuro-pneumonia. This disease was investigated in Assam. Epidemiology of the disease was studied and control measures were adopted. Data collected indicate that the disease has a tendency to spread by cattle movement. Analysis of 9 years data from 8 districts revealed that the incidence of the disease in Assam is rather erratic or irregular. Similarly there is no clear indication of any particular season for the occurrence of the disease. There were, however, more outbreaks during the period from April to December.

Clinical nutritional survey. A clinical survey of disease of animals caused by nutritional deficiencies was undertaken in different States. In Madhya Pradesh, Fluorosis among cattle was noticed and was attributed to feeding of *tiwari dal* and drinking of water which was found to have high fluorine content. In Madras delayed maturity in breeding bulls was noticed. Samples of sera from these bulls were tested for mineral deficiency without any conclusive results. In Bihar a deficiency disease

suspected to be due to calcium and vitamin B deficiency was investigated and data regarding its seasonal incidence, susceptibility, etc. was collected. A survey of 6 districts was undertaken in the Punjab but no evidence of presence or absence of trace elements deficiency was encountered. In Kangra district a weed (*Lantana camera* Linn.) which was previously reported to be poisonous was found to have no effect on the goats when fed, nor was anything poisonous found on chemical examination. Similarly no cases of Osteoperosis were found in Kangra Valley. In Assam more cases of iodine deficiency in cows were observed which responded to treatment with iodised salts.

Hump Sore (*Dum Dum Sore*). The incidence of this disease is reported to be very high in Orissa and every third working animal seems to suffer from it. Urea Stibamine was tried on affected animals, with no results. Application of antimony tartrate ointment was found effective but the disease reappeared after 3 to 4 months. In Bihar this affection was met with in Purnea district. Thirteen sets of deep scrapings obtained from lesions on microscopical examination revealed the presence of Microfilaria (*Stephanofilaria assemensis*).

Encephalomyelitis in sheep and goats occurred at Hissar Farm. All breeds of sheep and goats including Angora cross were affected. The mortality was higher in sheep than the goats. Efforts to transmit the disease in large and laboratory animals did not yield conclusive results. In Orissa this disease appeared in sporadic form from April to August. It affected pure Beetal goats as well as their F1 and F2 cross-bred progenies. Flocks both on the Farms and adjoining areas were affected. Other breeds of goats in contact with these remained free from the disease. Histopathological examination of brain, spinal cord, etc. revealed lesions associated with encephalomyelitis.

Sheep and Goat Pox. This disease was investigated in several States. In Mysore the incidence was rather high. Scratch and multiple acupuncture methods of vaccination were found suitable under field conditions while intradermal and sub-cutaneous methods of vaccination resulted in severe reaction. In two out-breaks double scratch method of ovination gave better results than a single scratch method. Ampouled sheep pox vaccine was found viable for nearly seven months. Passing of chloroform bubbles through the vaccine reduced the contaminating bacterial count considerably. A sensitized sheep pox vaccine using the anti-serum from recovered experimental sheep-pox virus donors was prepared. On inoculation controls and two sheep treated with uncarbolised serum developed very severe reaction while those inoculated with carbolised serum had decidedly a milder reaction.

In Bombay the disease occurred in epizootic form in winter season. Sheep (1536) were protected with vaccine obtained from Indian Veterinary Research Institute with satisfactory results. In an outbreak 62 sheep were satisfactorily vaccinated with vaccine prepared from strains of a virus encountered in an outbreak. In Madras, goats in the company of the affected sheep remained free. The affected animals had lesions all over the body. Vaccination proved to be ineffective in the face of an out-break. Efforts were made to study the comparative value of vaccines from Ranipet, (Madras) Mysore and Indian Veterinary Research Institute, but the results were unconclusive. In the Punjab immunity produced

in animals which were vaccinated with serum sensitized and glycerinated vaccines was tested at 6 and 9 months after vaccination. In the case of former vaccine the immunity was found solid upto 6 months; while after an interval of 9 months only 40 per cent of the animals proved immune. Animals given glycerinated vaccine did not show any immunity when tested after 7 months.

Enterotoxaemia. This disease was again investigated in Baroda. Investigation on the etiology of this disease was continued and typing of *Clostridium welchii* was undertaken. Transmission experiments were conducted. These anti-toxins were tested against the toxins obtained from cultures of the organism and one of these neutralised the toxin.

Diseases caused by Anaerobes. The scheme for the investigation of diseases of animals caused by anaerobes continued to function at the Indian Veterinary Research Institute. Purification of the anaerobic culture concerned in the causation of Black-Quarter which had been isolated in the previous year, was done. Robertson's meat and Deap Brains media were found suitable for maintaining stock cultures over long period.

Poultry diseases.

Like previous years survey of common contagious diseases of poultry was continued by the Assistant Disease Investigation Officers (poultry) in Madras, Punjab, Madhya Pradesh, Orissa and Mysore and useful data relating to epizootiology, symptoms, causes and mortality recorded and studied.

Ranikhet disease. Ranikhet disease continued to be the most common and fatal disease of the poultry throughout all the States. In most of the places it prevailed throughout the year. In Madras it occurred in all parts of the State. The introduction of the disease in most cases was traced to the purchases of new birds and *bazar* birds obtained for hatching and table purposes. In Bombay both typical and atypical forms of the disease were observed. In Bengal the disease has been found to have a seasonal occurrence. More outbreaks were reported during October to March compared with the period from April to September. In Madhya Pradesh, Assam, Punjab and Mysore birds of all breeds were equally affected. In Hyderabad outbreaks were reported mostly from city and suburbs of Hyderabad, but in Orissa the disease was not met with under village conditions while in Assam birds in Government Farms remained free from the disease and out-breaks were only reported from villages.

In all the States vaccination of clean birds against this disease was undertaken with satisfactory results. In Bengal as the disease had a seasonal occurrence mass inoculation centres against the disease were started early in April. During the period under review a very large number of birds were vaccinated in the various States under the poultry disease investigation scheme. In majority of the cases a satisfactory immunity developed, after a mild reaction. In some cases the reaction was more severe. In Madras about 20 per cent of the fowls developed drowsiness on the 5th or the 6th day and the laying hens went off laying for a period of 2 to 4 weeks. Paralysis was noticed in about 2 per cent of the vaccinated birds. In Bombay the only untowards reaction noticed was reduction or stoppage in egg laying which in some cases continued upto three months. In Madhya Pradesh chicks at various age-level (1 to 42 days) were inoculated and immunity was tested after 15 to 20 days. It

revealed that though the chicks can be inoculated at any age without untoward symptoms the best age for prophylactic vaccination was above nine days. Another experiment indicated that Ranikhet vaccine does possess some protective value for birds in the incubative stage. Immunity was found to be solid in birds that were inoculated two years previously. No reaction on reinoculation in laying birds protected in previous year was observed. In Orissa, 20 per cent birds got inappetance, 70 per cent dullness, 85 per cent fall in eggs and 2 per cent temporary lameness. Mortality among the vaccinated was as high as 9 per cent. In the Punjab only 2·6 per cent birds got temporary lameness, 0·7 per cent developed permanent paralysis and 0·8 per cent died due to reaction. In Bihar also the post-vaccination mortality was rather high, being 7 per cent.

Fowl pox. The disease occurred in its various forms in many States. In Madras the disease broke out in a virulent form in a number of poultry farms during winter months. In most cases it affected chicks between the ages of two weeks to four months. The chicks had the disease in cutaneous, ocular and diptheritic forms while in adults the lesions were confined to the comb and watlle. In Bombay, the disease is mostly confine to chickens and therefore appears more often during the hatching season. 70 to 80 per cent. mortality was recorded in chicks below the age of one month. The cutaneous form of the disease was more common. Chicks under the age of one month failed to acquire immunity on vaccination. Turkey chickens protected with fowl pox vaccine at 6 to 8 weeks age, became infected in a mild form at the age of 4 months. In West Bengal most of the outbreaks occurred during December to March, while the disease did not occur from June to November. In most States new vaccine produced at Indian Veterinary Research Institute was found to be effective. In Orissa, where the disease was noticed in all the districts, birds of all ages were equally affected. Desi birds appear to be more susceptible than the improved breeds. In Mysore out of eight outbreaks of the disease seven were of cutaneous type and one of ocular type. Vaccination with pigeon-pox vaccine was undertaken with satisfactory results. No constitutional disturbance in young chicks was noticed.

Fowl cholera. Practically no outbreaks of this could be confirmed in any State.

Tuberculosis. Tuberculin testing of poultry birds was further undertaken by the various Assistant Disease Investigation Officers in States. In Madras two cases of tuberculosis among Rhode Island Red hens were seen. Numerous caseating nodules were found in the liver and spleen of the birds, which were declared positive for T. B. Out of about 600 fowls and turkeys tested in Bombay, 14 fowls reacted positively. Put on a second test ten proved negative and in the positive ones lesions could be detected in only one case. In Madhya Pradesh after repeated testing the incidence of T. B. appears to be negligible in villages and towns. In the Punjab and Bihar all the birds tested were found to be free from T. B.

Spirochaetosis. This disease has been reported from Madras, Bombay, Madhya Pradesh, Bihar and Punjab. In Madras the disease occurred in fowls and chicks and was controlled by injecting Sulfarsenol. In Bombay sporadic cases occurred throughout the year. Gammexane was used with good results to control the tick vector, while Soamin was given

internally. This disease is very common in Madhya Pradesh and causes heavy mortality there. It occurs mostly before the onset of cold season and also at the end of the season. In Punjab after a survey it has been found that spirochaetosis causes enormous losses in the poultry. Outbreaks usually appear with the approach of summer and continue till middle of December; this period synchronizes with the activeness of the ticks. It is found to affect birds of all ages and breeds but is particularly formidable for heavy breeds and baby chicks. In Bihar dabbing the affected parts with methylated spirit was found to kill ticks in infested birds.

Coccidiosis. This is a fairly common disease of the poultry and occurred in most of the States. It was responsible for heavy mortality. Two to ten weeks old chicks mostly got the disease in Madras which on examination revealed *Eimeria tenella* and *E. mitis.* Sulphamezathine and Soluthiazole were found effective as curative in Madras as well as in many other States. In Bombay turkey chicks also got the disease and in addition to *E. tenella, E. meleagrimitis* was also detected. In West Bengal Sulphaguanidine gave satisfactory results. In Madhya Pradesh also chicks between the ages of 2 to 12 weeks were affected and both caecal and intestinal forms of the disease were encountered.

Helminthiasis. Helminthic infection of poultry was encountered in most of the States and the common worms were detected on post-mortem and faecal examination. Normal worm burden was studied in 293 fowls. Seventy-nine per cent of alimentary canals showed worms of either cestode or nematode types. Twenty seven per cent of birds had combined infection of both cestodes and nematodes. In Madhya Pradesh Phenothiazine and tobacco were used for eradication of normal worms. Between these two phenothiazine was found to be superior. Normal worm burden was determined in 9 birds in the Punjab that had died of helminthiasis and counts showed tape-worms 9·8 per cent, Ascaridia 24·8 per cent and Heterakis 94·0 per cent. In Assam 10 per cent of the faecal samples showed the infection but carcases of 80 per cent chicks showed the worms on post-mortem. Here it was observed that Desi fowls can withstand worm infestation more than imported breeds. Phenothiazine was found efficacious for treatment of round worms while Cestrasol also gave encouraging results. In Madras, however, Phenothiazine and Cestrasol were found ineffective for the control of round and tapeworms. Carbon tetrachloride was found to be effective for the eradication of *Ascaridi-galli* in Orissa. In Madhya Pradesh the superiority of Cestrasol over colloidal iodine as an effective taenifuge was further continued.

Avian Leucosis Complex. In Madras a few cases of this disease arose in exotic birds and were found positive on histopathological examination. In Mysore the disease was prevalent on all farms where improved breeds of poultry were maintained. The disease was noticed particularly when the pullets began to lay and cockerls came to age. It occurred in three Government Farms in Mysore. Cases were also suspected in Punjab and Bihar.

Contagious Coryza. This disease was reported from Madras and Mysore. In Madras it prevailed among the chicks and pullets and was responsible for great economic losses. The disease was severe during winter and rainy season, with high cold winds. *Pasteurella* organisms pathogenic to pigeons and rabbits were found in the nasal discharge of the

affected fowls. These were, however, non-pathogenic for fowls and ducks. In Mysore this disease was encountered on all the Government poultry farms where improved breeds are kept. Chicks between 2 weeks to 4 months were the most sufferers especially between the months of November and February and during the period of monsoon. In Madras vaccination of healthy birds with fowl-pox and *Pasteurella* vaccines together with disinfection of poultry houses gradually controlled the disease.

Ectoparasites. Ectoparasites (lice, ticks and mites) were noticed in poultry in almost all the States. In Hyderabad five per cent Carbolic acid ointment was successfully used to remove fleas. Scaly leg caused by *Cnimedocoptes mutans* was effectively treated with kerosine oil and linseed oil in 1:2 ratio together with two per cent sulphur ointment. In the Punjab 3 to 6 per cent solution of Derris powder proved effective for the control of ticks. In Madras, West Bengal and Madhya Pradesh dusting with D.D.T. and/or Gammexane gave good results for the control of ticks and lice. Scaly legs was successfully treated by the application of 'Ascabiol' and 'kerosine emulsion'.

Coordinated schemes on Helminthiasis

The schemes of helminthic infestation of livestock continued to function at the Indian Veterinary Research Institute, the University of Lucknow and Madras and West Bengal Veterinary Colleges.

In *Madras* transmission experiments with *Ascaris vitulorum* were undertaken. Repeated attempts to infect calves with eggs given orally, subcutaneously and intravenously failed to yield larvae or adults on postmortem but guinea-pigs were affected to some extent. A study of the capacity of eggs to develop normally after varying periods of storage in faeces or worms themselves, was made. The eggs appeared to possess extraordinary resistance. A study of the life history of the mites connected with the life history of *Monezia* species was made and transmission experiments were made but the results were inconclusive. A relationship was found to exist between the mite and the soil, humidity and rains.

In *Lucknow* study of the life-history of *Monezia expanse* was completed. During this year it was possible to recover all the stages found in the mites including the spherical embryo, pyriform larva, vermiform larva and cysticercoid stages. Further work on the life history of *Avitellina centripunctata* and *Stilesia globipunctata* was continued. Considerable work was also done about the life history of *Paramphistomum cervi.*

In *Bengal* morphological characters of *Eurytrema pancreaticum*, were studied. At the Indian Veterinary Research Institute, administration of 0·25 and 0·5 per cent copper sulphate was found to be effective against *Gastrothylax crumenifer* in the artificially infected cases. The snail *Indoplanorbis exustus* was found to be infected with cercariae of *Schistosoma indicum.*

Infestation of cattle with amphistomes was observed in several States. In *Madras* it was detected for the first time this year, and occurred in low-lying areas. Treatment with copper sulphate and ferri-sulphate gave good results. In *Uttar Pradesh* carbon tetrachloride given in doses of 6 c.c. gave good results but in some cases did not effect complete cure. In *West Bengal* however, treatment with copper sulphate was found ineffective.

Hexachlorethane (5 drachms for adults and 2½ drachms for young ones) was found to be effective for treatment of paramphistomiasis in sheep and goats. In *Orissa Ascaris* infestation in calves upto 6 months is reported to be heavy. Tetrachlorethylene was found to be effective. It was noticed that it must be followed by a purgative; 'Diaquone' was found suitable. Mepacrine was found to be effective for the treatment of Ascariasis.

Toxicology of indigenous drugs

In Madras the scheme for investigation of indigenous drugs with special reference to their toxic principles and devising of suitable antidotes continued to function. During the year eight plants were under investigation. *Gloriosa superba* after feeding experiments, was found to be non-toxic to ruminants. It was, however, toxic to dogs. Further experiments to determine the insecticidal value of essential oil extracted from *Acorus calamus* were undertaken, but the results were not encouraging. An alkaloid was extracted from *Anona squamosa* but it was found to possess no potent pharmacological action.

A scheme for collecting and collating information on indigenous drugs used in veterinary medicine from ancient literature and Sanskrit manuscripts was initiated with effect from 1 June 1949 and a retired Veterinary Officer with previous experience of similar work was put in charge with headquarters at Madras. He has submitted the following translations.

(a) Chapter 9—Fevers
(b) Chapter 19—Disease of eyes. } From part I of a Veterinary treatise called Palakapya.
(c) Chapter 46—Worm Infestation Aswa Vaidyaka
(d) Compilation of some of the ailments of cattle collected from recent publications and information received from provinces.
(e) Prescriptions for certain common diseases of cattle.

As a counterpart, a scheme has been sanctioned for a period of 6 months with a view to obtaining the prescription of indigenous medicines actually used by the village practitioners as well as in the veterinary hospitals so as to enable their scientific basis being assessed. The scheme will start working in 1950-51 in Northern India with New Delhi as its headquarters.

Damage to hides and skins due to warbles, ticks, etc.

(a) *Warble flies.* Under the scheme of research into the control of warble fly pest four areas were selected round Dehra-Dun. One of these was allotted for dressing, one for singeing and the third one for dressing and singeing operations. The fourth acted as control. Dressing operations were taken up in early October and terminated in January as the previous experience with the life-history indicated it to be the proper time. Tobacco-lime mixture and Derris powder were used. With the former a larval mortality of only 82 per cent was obtained whilst with Derris powder a kill of nearly 100 per cent was secured. The Derris powder besides its superior larvicidal value had several other advantages. Being powder it could be carried and applied easily. The tobacco-lime mixture is not easy to prepare and handle. Moreover it has to be steeped in water for 24 hours. As a result of dressing the percentage of warble infestation was brought down to 25 from 37. Similarly the data collected in the area

where both dressing and singeing operations were undertaken showed the percentage of infestation to drop down to 28 from 46. As reported earlier DDT proved to be ineffective for the destruction of warble fly eggs. It is therefore, calculated that singeing of the egg is practically the only method which could be utilized as a preventive measure. It is reported that due to singeing the incidence of warble infestation come down from 39 to 30.

Ticks. As a result of survey undertaken in Punjab and Uttar Pradesh observations on the geographical distribution and seasonal occurrence of *H. aegyptium* and *B. microplus* (*australis*) were made. Comparatively the former was found to be more widespread and the seat of predilection of this tick was the abdominal portion of the animal. *B. microplus* was mostly found behind the ears of infested cattle. The infestation is found to be heaviest during summer and rainy seasons and on the other hand ticks are rarely seen from mid-November to mid February on the animal body in Northern India. A study of the microtome section of the damaged hides and skins showed that the severity of damage indicted by continuously feeding ticks is greater than that inflicted by interrupted feeders. Adult stage of the *B. microplus* was found to cause more damage than its nymphal stage. The tickicidal effect of the DDT emulsion in kerosine oil and liquid soap was found to be reduced if the powder was left exposed to air. It is therefore essential that either fresh solution should be used or air-tight containers should be employed. As a result of 'Gammexane' dusting the metabolic deterioration on the oviposition of engorged female ticks was demonstrated. A statistical compilation of the data has indicated that there is a reduction of 30 to 40 per cent in the number of eggs laid by treated female ticks and not more than 10 per cent of the eggs laid hatch into active larvae. Hexyclan powder is found to be reasonably effective for control of ticks in their larval, nymphal and unengorged adult stages. The engorged tick is however resistant.

Minor biological factors. A survey of hide and skin godowns was undertaken in Uttar Pradesh at Bareilly, Agra and Kanpur. The incidence of *Dermestes vulpinus* was found to be—Bareilly 62·3 per cent, Arga 72·9 per cent and Kanpur 72·75 per cent. A large number of drugs like extract of leaves of *neem*, kerosine oil, napthalein, arsenieal compounds, etc. were tried as prophylactic against this beetle but all these substances afforded only partial protection.

Other Items

Research Fellowships (Animal Husbandry). In 1948 the Research Reorganization Committee of the Council recognized the general paucity of qualified men in the various branches of agriculture and animal husbandry and recommended that this deficiency should be remedied by setting up a system of research fellowships under specialists as had been done in respect of agricultural entomology and mycology. The Council has accordingly sanctioned research fellowships each of two years duration in Animal Pathology, Animal Bacteriology, Animal Physiology, Animal Parasitology [(i) Protozoology and (ii) Helminthology] and Animal Genetics. These scholarships will be awarded at the rate of one scholarship for each subject in alternate years during the next six years and the duration of each scholarship is to be for a period of two years.

Bee-keeping. Further work on breeding, biometry, behaviours and bionomics, bee-management, pasturage, role of *Apis indica* F. in pollination of various fruits and seed crops and on the composition of honey was carried out at the All-India Bee Research Station, Katrain, (Kulu) Punjab.

It is a well known fact that bee-keeping is important not only from the point of honey production, but more so for the value of bees as pollinators of various fruit and seed crops, which results in higher yields.

Observations made regarding this aspect of bee-keeping show that under natural conditions the percentage of setting in pear and apple was 37·5 and 46 per cent respectively as compared to 12·8 and 1·9 per cent when no insects were allowed to visit their blossoms and the honey bee formed 66·8 to 77·21 per cent of the total insect visitors to these blossoms. It is intended to study the real utility of bees as pollinators in terms of increased yields in respect of field crops such as *toria*, *sarson*, berseem and vegetable seed; crops like cauliflowers, cabbage, turnips, radish, carrot and onion, etc.

The Council has set up *ad-hoc* Committee for the collection and reviewing of all available material on bee-keeping and to indicate ways and means for its development in the various States of India.

Fish and fisheries. Under the Rural Piscicultural Scheme, Madras, observations on the feeding and breeding habits on 16 species (*Barbus chrusapoma, Barbus curumuca, Osteochilus thomassi, Cirrhina roba, Labeo calbasu, Macropedu cupanus, Lepidocephalus thermalis, Hilsa kanagurta, Labeo boggut, Mystus cavasius, Carassius auratus, Garra mullya, Barbus dubius, Cirrhina mrigala, Labeo rohita, Megalops cyprinoides*) were made. The work on the acclimatization and transport of live fish was carried out which gave very interesting and valuable results. A series of experiments on the acclimatization of Chanos from salt water to fresh water showed that the mortality during the process was reduced to 0·2 per cent. The mortality during transport was 2·4 per cent. It was also ascertained that Chanos fry could withstand direct transfer to freshwater. Acclimatization experiments on *Mugil cephalus* (Forskalo) showed that the mullet fry are delicate and show a high percentage of mortality. *Barbus hexagonolepic* (McClell) fry, 50-80 mm. in size was found to stand transport well without any mortality. *Osteochilus thomassi* fingerlings were transported over a long distance successfully without any casualty. Adult Catla stood rail transport well over a distance of 100 miles. *Osphronemus goramy* breeders and fingerlings were successfully transported over long distances. In the case of *Etroplus suratensis* there was about 50 per cent mortality in a consignment transported over a distance of 1,300 miles. Experiments to induce artificial spawning of carps that had been planned to be carried out at the Chetput Fish Farm, could not be conducted owing to the failure of monsoon during the year. Some preliminary work has been done in connection with the effect of factory effluents, migratory movements of fishes, the effect of certain chemicals on weeds and other aquatic vegetation and other problems.

Under the Fisheries Scholarships sponsored by the Council, the following four problems were allotted to scholars to be worked out at the Calcutta University:

1. Production of food in fishery ponds suitable for major carps and seasonal variation of food of carps.

2. Ecology of *Mugil parsia* in the salt water *bheries*.

3. Life history and bionomics of *Clarius batrachus*.

4. Life history and bionomics of *Mugil parsia*, etc. in different stages.

Although considerable work has been done and a fair amount of useful information collected, the progress has not been generally very satisfactory; and the scheme No. 3 above was given up due to the continued ill-health of the scholar concerned.

Another scholarship for studying problems on the control of animal pests of stored fish was awarded to the Travancore University. During the first half year, 200 samples of representative types of dried fish and prawns were obtained from 48 different godowns and stores for examination. Seven different types of pests (including 5 insects and 2 mites) were isolated for study. Two of these have been identified, while the pest *Dermestes* sp. which infests both salted and unsalted dried fish, has been found to be most destructive of all. The study of its life-history has been initiated. Results of considerable value are likely to be achieved from the study of the life histories of these pests and methods and factors responsible for their infestation.

The Governing Body of the Council has approved the transfer of the Fisheries Research to the Central Fisheries Research Institutes under the Ministry of Agriculture and the Government of India have been addressed accordingly.

CHAPTER V—DELHI DEVELOPMENT SCHEME

General

Thanks to the very keen interest evinced by the Hon'ble Minister for Food and Agriculture it has been possible recently to harness the co-operative spirit among the villagers for the purpose of building a small culvert in village Shamepur where the absence of a culvert was causing considerable difficulty to the people of area. The Hon'ble Minister visited the village two times in this connection and within a very short period it was found possible to provide this amenity entirely through voluntary financial and material contribution from the village folk. Another bigger example of co-operative effort is the construction of canal bridge costing about Rs. 10,000 at village Badli with the help of the Irrigation Department, Punjab. The construction work was done by the Irrigation Department while all the earth work was done by the villagers themselves.

Activities

The Scheme continued its work during the last year. The following is a brief statement of its activities:

Agriculture. Arrangements were made for the distribution of seed of *jowar*, maize, cotton, *guar*, wheat, gram and potatoes, vegetable seeds and fruit plants during the year. Side by side with this, facilities were also provided with the help of the Plant Protection Adviser to the Government of India, for the treatment of seeds and plants with insecticides. Sugarcane sets of the improved Coimbatore varieties were obtained from the Indian Agricultural Research Institute and distributed to the villagers. Improved types of sugarcane crushers have also been put up for demonstration purposes.

The following is a statement showing the quantities of various seeds purchased and distributed during the year:

Wheat	560 md.
Gram	2,650 md.
Maize	25 md.
Jowar	1,800 md.
Potatoes	124 md.
Fruit Plants	3,200
Vegetable seeds	3,341 lb.
Sugarcane	565 sets.

Introduction of improved implements. The number of improved ploughs sold so far and expenditure and receipts in that connection are as under:

Number of ploughs purchased	Number of ploughs sold	Expenditure	Receipt
731	617	Rs. 8,857	Rs. 7,454

(200 shares of ploughs have been sold).

Improved manuring. The villagers were encouraged in the production and use of farmyard manure. Hundred trucks and 2,500 cart loads of

unscreened manure have been arranged during the year. A power machine for screening was manufactured at the Indian Agricultural Research Institute, but this did not prove very successful. Other measures are being adopted to screen this manure in order to make it useful in application to agricultural fields.

Horticulture. With the aid of the Fruit Development Adviser to the Government of India, arrangements were made for providing improved vegetable seeds and selected fruit plants. Shade tree plantation was encouraged during 1949-50, and a large number of such plants were distributed during this period. Gardens already existing in the villages are lying in a very uncared for condition with the result that there is more vegetation than fruits. Trimming and pruning of these gadrens has been done wherever the owners agreed to implement the recommendations of the Department and some new orchards have also been planted on improved lines. A scheme for starting nursery at Shahibabad Daulatpur has also been drawn up.

Animal Husbandry

Breeding. All the scrub bulls in the villages have been castrated. Artificial insemination centres could not be set up as originally intended, as the local breeders and cattle owners were not in favour of adopting this practice. Every village has been provided with a number of approved bulls sufficient to serve the cows and buffaloes in the village.

This tract, as a whole, being deficit area for fodder, fodder producing schemes have been chalked out for the *kheti* area and the cultivators have been made to understand the value of green fodder. Efforts are being made to supply concentrates whenever required.

Fisheries. Tanks in seven villages have been stocked with fingerlings. The intention is that after deducting all the expenses, the sale proceeds would be given to the villagers to be spent for the common benefit of the people. So far, fish catches have been arranged in three tanks which gave a net profit of Rs. 562-12-0.

Poultry. In the first year the number of improved cockrols distributed was 51 and 18 hens while in 1949-50 it was 15 and 33 respectively. The number of birds exchanged was 57 hens and 29 cocks. The progeny of the birds supplied has shown good results as will be seen from the fact that some of the poultry keepers recently sold their birds for Rs. 7 each.

Improvement of pigs. A sustained effort is being made to improve the breed of pigs kept in these villages. For this purpose, three improved Yorkshire boars costing about Rs. 500 were imported from Aligarh for the purpose of upgrading the local pigs. One of the conditions of this work is that all the existing boars would be castrated and that each boar would be given only where at least 30 sows are already available.

Marketing. Even though it was intended to make arrangements for the transport and marketing of the milk produced in the villages, it has not been possible to take any action in this connection. This aspect of improvement is however receiving attention.

CHAPTER VI.—COMBINED AGRICULTURAL AND ANIMAL HUSBANDRY SCHEME

Village Rehabilitation Scheme, Baroda

This scheme was undertaken to study the influence on economic, social and other aspects of village life by comparing the various land tenures such as tenancy at will, land belonging to a proprietor, personal proprietorshop and cooperative and collective farming on holdings all of equal sizes. The results indicate that this scheme has proved beneficial to the villagers and that the proprietory system gives the best income. This Scheme is still in progress.

Soil Science

Scheme for the trial of different kinds of trees, shrubs and grasses in the semi desert tract of Shekhawati (Jaipur State) with the object of preventing soil-erosion by wind and to get suitable varieties of these plants, to increase fodder supply was sanctioned last year. It has not yet started.

Kudzu Vine, Indian Agricultural Research Institute

Kudzu vine is assuming an increasing importance in the soil conservation programme as soil binder and as affording an excellent fodder to the livestock. Its propagation on an extensive scale has been much handicapped because of its lack of, or poor, seed setting ability. The object of the scheme is to determine the environmental conditions that influence seed setting in the important vine as well as to compare the performance of different species of *Pueraria* occurring in India and which are recorded to set seed regularly.

Some crowns of kudzu vine were received last year from America through the Agriculture Department, U.S.A. They have since established themselves and are making good progress.

Fodder and Grasses

A scheme for finding out the methods of making silage most acceptable to the cultivators, to observe the effect of silage on the health of cattle and milk production and to attempt to popularise the silage making was sanctioned last year, in Patiala and East Punjab States Union but has not yet started.

Scheme for the improvement of pasture grasses and legumes, Indian Council of Agricultural Research

Realizing the urgent and vital need for developing pasture lands in India with suitable grasses and legumes which would yield palatable and nutritious fodder for livestock, the Council has prepared a model scheme for the improvement of pasture grasses and legumes in various parts of India on a regional basis. The scheme has been approved by the Advisory

Board and is being forwarded to the State Governments for suitable action. The principal objectives on the agriculture side of the scheme are:

(1) Collection of pasture grasses and legumes both indigenous as well as exotic from a wide range of places all over the world, as wealth of breeding material is the key to ultimate success.

(2) Breeding varieties possessing (a) wide adaptability, (b) good seed habit, (c) desirable vegetative characters including high yields and good forage, (d) low water requirements and drought resistence, (e) winter hardiness, (f) good response to fertilisers, (g) ability to produce sod and (h) disease resistence.

On the Animal Husbandry side the following problems of pasture land in relation to animals are to be studied:

(i) The study of the palatability of grasses.

(ii) Animal behaviourism to pastures.

(iii) Parasitism.

(iv) Nutritive quality of grasses.

(v) Rotational grazing.

(vi) Conservation of grasses.

Regionalization of Agriculture and Animal Husbandry Research

A recent improvement that has been attempted in the Council's procedure for sanctioning schemes, the object of which is to avoid overlapping and duplication of work, is the regionalization of research. It has been felt that problems of crop production in two or more administrative units situated in the same region are at times similar, and unnecessary duplication of work can be avoided if research is undertaken on a regional rather than on a State basis. According to this system, research work would be classified as fundamental, regional or local; fundamental problems as far as possible would be carried out at the Central Institutes, the Universities and other stations such as Central Commodity Research Stations; regional schemes would be conducted on a contributory basis by the Council and the Government of the State best suited to take up a partciular item of research; and local schemes would be entitrely left to be undertaken by the States concerned at their own expense. Under this plan, it is expected that research work to be carried out on a particular science or a crop in a region with certain well-definited soil, climatic and other characteristics, would not be repeated in another place more or less having the same type of soil, climate and other characteristics. For the purpose of this plan, the country has been split up into five homogeneous regions on the agriculture side and four on the animal husbandry side. The actual description of these regions is practically the same for both agricultural and animal husbandry. These regions are as follows:

Agricultural side

(i) *Temperate Himalayan Region.* Consisting of two sub-regions, *viz.* the Eastern Himalayan Region including Assam (hilly parts), Sikkim, Bhutan, Nepal and the Western Region including Kumaun, Garhwal, Simla, Kulu, Chamba and Kashmir State;

(ii) *Dry Northern (Wheat) Region.* Comprising of Punjab, Western Uttar Pradesh, Western Madhya Pradesh, Madhya Bharat, Rajasthan and Patiala and East Punjab States Union;

(iii) *Eastern (Rice) Region.* Comprising of Assam, West Bengal, Bihar, Orissa, Eastern Madhya Pradesh, Eastern Uttar Pradesh and North East Madras;

(iv) *Southern (Millet) Region.* Comprising of Jhansi division of Uttar Pradesh, Madhya Pradesh, Madhya Bharat, East Hyderabad (Deccan), West Madras, Bombay and part of Mysore; and

(v) *Coastal Region.* Comprising of the two coastal strips in South Indian bordering on the Eastern and Western Ghats, parts of Mysore, Coorg and Travancore and Cochin States.

Animal Husbandry side

On the Animal Husbandry side, the regions would be the same as above excepting that the fifth region would be included in the Eastern (Rice) Region itself for the present.

The research proposals pertaining to or emanating from each region are examined by a special Regional Committee for that region consisting ordinarily of the Directors of Agriculture or Animal Husbandry, as the case may be, and the Directors of any Central Institutes that may be situated therein, with the Agricultural or Animal Husbandry Commissioner of the Council as the case may be, as the Chairman. The main functions of the Regional Research Committees are (1) to study problems of regional importance and suggest schemes for various items of work, (2) to classify schemes into different categories such as fundamental, provincial and regional and indicate the places where they can best be tackled. This new plan has so far worked only for a year and actual experience of this short period has shown that this new machinery is useful in avoiding duplication and overlapping of work. Final conclusions as to the usefulness of this method can however be reached only after it has worked for at least some more years.

CHAPTER VII.—STATISTICAL RESEARCH

Advisory Work

The Statistical Branch of the Council continued its advisory work relating to the design of agricultural and animal husbandry experiments and the interpretation of their results, examination of technical programmes and annual reports of the Council's schemes and the scrutiny of statistical papers received for publications in the Council's journals. A number of statistical equiries received from the Food and Agricultural Organization of the United Nations, Central Government, State Governments, Central Commodity Committees and other institutions were also dealt with.

Training

Sixteen students were admitted to the Certificate Course and seven to the Diploma Course in Agricultural Statistics during the year 1949-50. Three students were deputed by the State Governments of Bihar and Punjab for training in the Applicational Course.

Nine students passed the Certificate Course examination held in August, 1949. Four Diploma students submitted their thesis, three of which have already been approved for the award of the Diploma.

Twelve students of the Applicational Course 1948-49 were examined on the completion of the Course in May 1949 and all of them were declared successful. Three students of the 1949-50 Course were examined after the completion of the First Term in December, 1949 and all were declared successful. They are now continuing in the 2nd term of the Course which will finish on 31 May 1950.

Students of the Certificate Course were taken, as usual, to the Indian Agricultural Research Institute, New Delhi to study the problems in practical agricultural in various Divisions of the Institute. They along with Applicational Course students, were also taken on instructional tours during March 1950, to the Indian Veterinary Research Institute, Izatnagar and Veterinary College, Mathura. At these places they received practical training in the problems arising in the field of animal husbandry. The students of the Diploma Course paid a visit during March 1950 to the Institute of Plant Industry, Indore, where they studied the problems in Genetics and Field Experimentation as in the previous year. They also joined in the Instructional tour to Indian Veterinary Research Institute, Izatnagar.

Students of all the three Courses were taken to the villages under the Delhi Development Scheme of the Indian Council of Agricultural Research and they received training in the field work relating to random sample surveys for the estimation of acreage and yield under different crops.

International Training Centre on Censuses and Statistics for South East Asia and Oceania. Under the joint auspices of the Indian Council of Agricultural Research, the F.A.O., the Statistical Office of the United Nations and E.C.A.F.E. an International Training Centre on applied agricultural and demographic statistics for the benefit of the countries of South East Asia and Oceania was held in New Delhi for a period of 14 weeks commencing from 1 November 1949. The main purpose of the

Training Centre was to help member Governments in developing their censuses and sampling techniques as applied to population and agriculture and to disseminate information on international recommendations regarding agricultural and population censuses to be taken up around 1950. In addition to delegates from States of India, over 35 delegates from Burma, Pakistan, Nepal, Indonesia, Ceylon, Indo-China, Korea and Thailand participated.

Research

Crop cutting surveys. The crop cutting experiments by the random sampling method which were started during 1943-44 were continued during the year under report on wheat in the States of Uttar Pradesh, Bihar, Madhya Pradesh, Punjab, Ajmer-Merwara and Delhi; on paddy in Madras, Uttar Pradesh, Madhya Pradesh, Assam, Orissa and Coorg, on *jowar* and *tur* in Madhya Pradesh and on gram and *masur* in Bihar. The co-ordinated scheme, prepared by the Statistical Adviser, Indian Council of Agricultural Research for extending the scope of the experiments to major foodgrains corps in all Part 'A' States of the Union has been approved by the Government of India and is to be financed from the food procurement bonus accrued to the respective States. The State Governments have been addressed to implement the scheme from the *rabi* season of 1949-50.

The question of extending the scope of co-ordinated scheme to include Part 'B' States (former States and States Unions) is also under the consideration of the Government of India. It is expected that experiments will be initiated in these States from the *kharif* of 1950.

Similar schemes for estimating the yield of non-food crops like cotton, sugarcane and oilseeds, have been formulated at the instance of the respective commodity committees and are likely to be implemented during the next year.

Assessment of results on 'Grow More Food' campaign. At the instance of the Commissioner of Food Production, Government of India, the Statistical Adviser prepared a scheme for estimating additional production due to the various measures of 'Grow More Food' campaign. An *ad hoc* Expert Committee was constituted by the Council to consider the scheme and finalise the technique. The Committee met for the first time during September 1949 and recommended that the States should undertake pilot survey on the lines prescribed by them during the year under report. Accordingly an enquiry was carried out by the State of Madhya Pradesh in two districts of Bhandara and Balaghat during the *kharif* season for estimating the additional production of paddy. The results of the enquiry were found to be satisfactory and it is expected that it would be extended on a statewide scale during the next *kharif* season. Meanwhile pilot enquiries on the *rabi* crop also have been planned to be conducted in the states of Uttar Pradesh, Madhya Pradesh and Bombay.

Marine Fishery Statistics. An exploratory survey with the object of investigating the possibility of estimating the total catch of fish by the method of random sampling is being carried out in the Malabar coast of the country. As a preliminary to the survey, a complete census of all the boats, nets and other implements used for fishing is taken in all fishing villages on the coast which are grouped into 24 sets of 4 neighbouring

villages, each in charge of an enumerator appointed for the purpose. It is proposed to try several alternative schemes of sampling for a couple of months in the initial stage and to decide upon the ultimate scheme of sampling to be actually adopted after studying the relative merits of the different schemes from the point of view of their practicability.

Aerial photography. The survey of aerial photography could not be taken up this year also, as the requisite material for identifying the crops through colour filters was not available. It is, however, proposed to do the work during the next year.

Pilot survey on Agricultural Census in Delhi Development Scheme. With a view of gaining experience for an efficient planning of the contemplated country wide agricultural census in 1950-51 as recommended by the F.A.O., a pilot agricultural enquiry was conducted in the 10 selected villages of the Delhi Development Scheme. The opportunity was availed of to give practical training to the delegates of the International centre on the actual method of conducting the census.

Livestock statistics. The scheme for the improvement of livestock statistics was to have been carried out during the year under report in one district each in the States of Uttar Pradesh and Madhya Pradesh. This could not be done in Madhya Pradesh as rinderpest among cattle was prevalent in the State. In the case of Uttar Pradesh, preliminary work is being done. The complete survey will, therefore, be carried out during the next year.

The Statistical Adviser, Indian Council of Agricultural Research, prepared three schemes, *viz.* (i) for evolving a suitable method of sampling wool from the body of sheep and from commercial bulks for measurement of quality of wool, (ii) award of fellowships to students of the Diploma Course in Agricultural Statistics for carrying out research in statistics, and (iii) statistical analysis of data collected in the sheep breeding schemes at Hissar and Mysore. The first two schemes have been sanctioned by the Governing Body of the Council and will be implemented during 1950-51. The consideration of third scheme has been postponed for the next year.

Analysis of the data of the Punjab Sheep Breeding Scheme. A general prejudice is prevalent amongst sheep breeders against breeding white-faced Bikaneri sheep and it is believed that they possess a weak constitution. A scheme for analysing the data relating to head colour collected under the Council's Sheep Breeding Scheme in the Punjab, has been started with a view to examine whether there is any foundation for such a belief or not.

The following research work was published by the staff of the Statistical Branch, Indian Council of Agricultural Research, during 1949-50:

(1) On a method of estimating Mineral Metabolism Requirements in Animal by Dr. P. V. Sukhatme, V. N. Amble and S. S. Prabhu (*Journal of Indian Society of Agriculture Statistics*).

(2) Sample surveys on Agriculture, Presidential address by Dr. P. V. Sukhtame (*Indian Science Congress Association, January* 1950).

(3) Further contributions to the theory of probability distribution of points on a line. By Dr. P. V. Krishna Iyer. *Part I, J. Ind. Soc. Agric. Stat.*, Vol. 2, Part 2 (1950).

(4) Difference Equations of some Moment Generating Functions for some probability distributions. By Dr. P. V. Grishna Iyer. *Nature*, 165, p. 370 (1950).

(5) Probability distribution of points on a line. By Dr. P. V. Krishna Iyer, *Sci. and Culture*, Vol. 15, p. 200 (1949).

(6) Radom Association of points on a Lattice. By Dr. P. V. Krishna Iyer, *Current Science*, Vol. 19 (1950).

(7) A Pitman Test for multiple correlation by Dr R. D. Narain. (Abstract) *Proc. Ind. Sci. Congress* (1950).

(8) A characterization of the multivariate normal distribution—by Dr. R. D. Narain. (Abstract) *Proc. Ind. Sci. Congress* (1950).

CHAPTER VIII.—GENERAL

Publicaations

Indian Farming. There has been a gradual rise in the number of subscribers. Whereas the number of paid subscribers at the end of last year was 818 only, it was 1,173 on 31 March 1950. The Journal, however, still remained in arrears on 31 March 1950 by the following issues:

(1) November 1949.

(2) December 1949.

(3) January 1950.

(4) February 1950.

(5) March 1950.

Scientific Journals. The position of scientific journals was comparatively more favourable. It has not however been possible to release most of the issues of *Indian Journal of Agricultural Science* due to non-fixation of its price. It is hoped that the Journal will now be released fairly at regular intervals.

Kheti. The publication of *Kheti*, the Hindi counter part of *Indian Farming* commenced from May, 1948. During a very short time it has obtained popularity and it is hoped that it will fairly compete with *Indian Farming* very soon.

Occasional Publications. A manual on '*Feeding of Farm Animals in India*' by Dr. P. E. Lander which was prepared under the auspices of the Council was published by Messrs MacMillan & Co., Calcutta during this year. The manual is one of the series of manuals on agriculture and animal husbandry to be published through the above press. The release of the manuals on '*Dairying in India*' by Professor J. N. Warner and on '*Animal Nutrition*' by Dr Sen is expected shortly.

The Council has taken in hand the preparation of *Hand Book on Indian Agriculture.* This book will include a number of chapters on agriculture, animal husbandry and allied subjects written by eminent experts. More than half the chapters have been received in and the remaining are expceted to be received soon. It is hoped that the Council will be able to issue this book before the end of 1950-51.

Publications Committee. The Committee considered the general question of granting subsidies to various scientific bodies for the printing of their journals. It was pointed out that before actually taking up the consideration of grant of subsidy to any scientific body which applies for such a grant the Council should seek information as to its sources of income and also its total annual income.

It was laid down as a matter of principle that sanction should ordinarily be given to scientific organizations which published journals having a direct bearing on agricultural production, and which were constituted on an all-India basis.

The Committee recommended that a maximum amount should be earmarked for grant of such subsidies and suggested that this amount should be fixed at Rs. 15,000 in the first instance. The Committee also recommended that the grant of subsidy should be limited to a period of five years for each society or journal and that after this period the grant shou'd, as a general rule, be stopped.

The Committee agreed that in the case of a society to which a Council has sanctioned a subsidy, the annual renewal of the subsidy might, subject to the fulfilment of the specified terms and conditions, be allowed after receiving a satisfactory report on its journal by the Expert Advisers of the Council.

Subject to the usual terms and limitations, the Committee recommended grant of subsidy to the Indian Phytopathological Society and the Indian Journal of Helminthology. The Committee did not consider that the Zoological Society of Bengal was an organization of all-India importance and therefore could not accede to its request for a grant of subsidy.

(ii) The Committee agreed that as the publications comprise a permanent activity of the Council, the expenditure in connection with the Editorial staff should be considered as a standing charge of the Council and should be provided for in the Council's budget annually till the Government of India could be persuaded to take over the scheme.

(iii) The Committee recommended the revision of following publications which had become out of date:

(a) Scientific Monographs Nos. 1 and 12 entitled '*The Fungi of India*'.

(b) *A Hand Book of Statistics for use in Plant Breeding and Agricultural Problems.*

It was also agreed that the revision of the first publication should be entrusted to Dr Mundkur and of the second to Dr Sukhatme and Dr Panse.

(iv) The Committee recommended the preparation of an illustrated hand book on Indian fodder and forage plants.

(v) The Committee continued to receive valuable assistance from a large number of specialist referees in the examination of papers received for publication.

General. In view of the changed political situation and also to ensure better diffusion of scientific knowledge in India and abroad, the free and exchange distribution list of the Council has been revised.

Library

In pursuance of its objects to aid agricultural research, the Council maintains an up-to-date research and reference library for the use of its officers and persons actively engaged in research work in agriculture and cognate sciences in the States of the Indian Union. The library has a valuable collection of 75,000 volumes on agriculture, animal husbandry and allied subjects, made up of books 10 per cent, pamphlets 40 per cent and periodicals 50 per cent. It gets about 600 scientific and technical journals of which 150 are subscribed and the rest are received through exchange relations which the Council has with scientific institutions and societies all over the world. Besides these journals, the library receives a large number of technical pamphlets, bulletins, circulars and leaflets by virtue of exchange with agricutural and veterinary research institutes and experiment stations.

The main library is located in a wing of the building housing the Linlithgow Library of the Indian Agricultural Research Institute, Pusa,

New Delhi, and a section of the library is attached to the office of the Council at 'P' Block on Raisina Road to serve the needs of the officers, the teaching and technical staff and students of the certificate and diploma course in statistics conducted by the Council. It would greatly add to the usefulness of the library if the two sections into which the library is split up at present for want of accommodation, could be centralized and located in the same building as main office.

Library Statistics. The total number of books and publications in the library on 31 March 1950 was 74,827 as against 70,139 last year. 4,688 new books and publications were added during the current financial year as against 3,452 last year.

The loan of books and circulation of periodicals reached a total of 18,922 against 17,855 last year. This figure does not include a large number of books and periodicals consulted in the library by the officers, students and research workers. A particularly heavy demand was recorded for books on statistics required by the students of the Training Courses in statistics. Some of the books were in such a large demand that they had to be declared as 'Book not to be issued out' so that they could be freely consulted by all in the Library Reading Room.

Classification and Cataloguing. All new additions of books and publications are accessioned, classified and catalogued. A card catalogue comprising author, subject and analytic entries arranged on dictionary basis, is maintained up-to-date. A classified shelf card catalogue based on decimal classification is also duly maintained. Besides, this, a printed catalogue together with typed lists of monthly additions to the library is available for consultation in a handy form.

Reference and Information Service. As indicated in the previous report, the Council's library maintains an information and bibliographical service on topics relating to agriculture and animal husbandry, for the aid of the research workers all over the country. Important articles on specific topics relating to agriculture, veterinary and allied sciences are indexed and abstracted from about 400 scientific and technical journals. Horticultural literature abstracted by the Horticultural Abstractor of the Council is also indexed. The indexed cards form an important source of latest information available for reference. It is, however, regretted that the information and bibliographical service maintained in the library could not be further developed and kept up-to-date during the year under report owing to the shortage of the technical hands in the library throughout the year. It may be mentioned that during the year under report the library supplied to officers and research workers references on a large number of topics some of which are mentioned below:

Rabbit keeping, grazing, information on 'coleus', Agricultural education and research in India, List of Farmers Association in India, Cultivation of sweet potatoes, etc.

A press cutting service has been recently introduced in the library. Cuttings of important activities of the Council on agriculture and animal husbandry research and development and allied topics are taken from important newspapers and circulated to the officers and later preserved for reference purposes.

The library has proved very useful not only to officers and staff of the Council as indicated by the references asked for by them but its services were freely availed of by the officers of other Ministries and States, particularly of Veterinary and Agricultural Departments. The following are some of the Government Departments which made requests for loan of books from the Council's Library during the period under report:

(1) Zoological Research Laboratory, Madras.
(2) Dairy Research Institute, Bangalore.
(3) Indian Standards Institute, Delhi.
(4) Agricultural College, Coimbatore.
(5) College of Agriculture, Banaras.
(6) Livestock Farm, Hissar.
(7) Government of Orissa.
(8) Indian Veterinary Research Institute, Izatnagar.
(9) Madras Veterinary College, Madras.

In addition, the Library extended its services to people who are not connected with the Council or as a matter of that with the Government either at the Centre or in the States. Requests for loan of books from individual persons as well as from private concerns were also recently complied with.

APPENDIX

APPENDIX

Annual Account of Income and Expenditure of the Indian Council of Agricultural Research for the year 1949-50

RECEIPTS				PAYMENTS			
Head of Accounts	Receipts during the year	Grants Original	Grants Net	Head of Accounts	Expenditure during the year	Excess(—) or Savings (+) over net grant	Remarks
	Rs.	Rs.	Rs.		Rs.	Rs.	
				A.—STANDING CHARGES			
I. Opening balance at							
(*i*) Imperial Bank of India .	11,12,486 8 3			1. Accounts and Audit.	27,844 12 6	(—)4,044 12 6(*a*)	(*a*) Excess due to payment of average cost of the post of Accounts Officer provisionally pending settlement of exact amount payable.
(*ii*) Post Office	34,110 6 9*	28,000	23,800	2. Travelling allowance of non-official members of the Council	3,331 9 0		
II. Receipts under the Agriculture Produce Cess Act	21,84,160 15 0	9,000	3,400				
Deduct.—amount transferred to Reserve Bank.	2,50,000 0 0						
				3. Travelling allowance of members of the Committees of the Advisory Board and of other persons invited to attend the meetings	14,418 8 0	(+)68 7 0(*b*)	(*b*) Inconsiderable.
	19,34,160 15 0	24,000	13,400			(—)1,018 8 0(*c*)	(*c*) Excess due to more claims having been paid within the year than was anticipated.
III. (*a*) Grants from the Indian States:							
(*i*) Mysore . . .	10,000 0 0						
(*ii*) Baroda . . .	..	1,000	..	4. Travelling Allowance non-official members of the Board of Agriculture and Animal Husbandry in India.	..	..	
(*iii*) Kashmir . .	5,000 0 0						
(*iv*) Travancore . .	10,000 0 0						
(*v*) Cochin . . .	..	3,000	1,500	5. Miscellaneous	1,567 6 0	(—)67 8 0(*b*)	
(*vi*) Bikaner . . .	..						
(*vii*) Bhopal . . .	2,500 0 0						
(*viii*) Jaipur . . .	20,000 0 0						
	47,500 0 0						
				B.—RESEARCH, TRAINING AND PUBLICITY UNDER DIRECT CONTROL OF I.C.A.R.			
				(*i*) *Agriculture*			
(*b*) Grants from the Central Government.		..	92,500	1. Indian Institute of Fruit Technology.	95,751 3 11	(—)3,251 3 11(*d*)	(*d*) Excess due to payment of arrears of pay late in March 1950.
(1) Scheme of crop yeild estimation by aerial photography.	2,375 0 0	8,230	8,600	2. Soil and climatic conditions of cashewnut.	9,767 3 0	(—)1,167 3 0(*e*)	
(2) Co-ordinated Research scheme for the control of wheat rust in India.	63,000 0 0	25,000	12,430	3. Ladies training in fruit preservation.	12,933 13 9	(—)503 13 9(*b*)	(*b*) Inconsiderable.

Only transactions at the Post Office were not passed through the Cash Book which is being done since 1 June 1949.

(3) cheme of insect pests of stored oilseeds	146 10 8	..	13,680	4. Description of different varieties of fruits.	14,481 8 0	(—)	801 8 0 (*b*)	(*b*) Some claims were received very late in the year.
Crop-cutti experiments (4) Wheat and Paddy).	1,86,000 0 0	9,000	8,300	5. Abstraction of horticultural literature.	8,506 12 0	(—)	206 12 0 (*b*)	
(5) Indian Institute of Fruit Technology.	72,200 0 0	..	1,240	6. Green manuring survey . .	1,833 2 0	(—)	593 2 0 (*e*)	
		..	240	7. Monograph on mixed cropping practices.	153 4 0	(+)	86 12 0 (*b*)	
		..	..	8. Monograph on insect pests of cultivated crops in India.	182 4 0	(—)	182 4 0 (*f*)	(*f*) Demand for funds received late.
				(*ii*) *Animal Husbandry*				
IV. Interest from investments—								
(*i*) 2¾ per cent. loan 1962 . .	26,059 8 0	8,000	600	1. Characteristics of grey breeds .	545 14 0	(+)	54 2 0 (*b*)	(*b*) Inconsiderable.
(*ii*) 3 per cent. loan 1963-65 .	49,361 4 0							
(*iii*) 3 per cent. 2nd Victory loan 1959-61.	14,962 8 0	56,000	..	2. Utilization of kitchen swill as food for livestock.	..		..	
(*iv*) 3 per cent. fixed loan 1957 .	55,546 12 0	14,800	300	3. Cattle Insurance Committee .	322 0 0	(—)	22 0 0 (*b*)	
(*v*) Fixed deposits, etc. . . .	18,801 4 0	1,000	..	4. Monograph on maintenance of farm animals in health.	..		..	
	1,64,731 4 0							
Deduct—amount transferred to Reserve Fund.	45,000 0 0							
	1,19,731 4 0	700	..	5. Manual on 'Preparation of animals for Indian Markets.'	..		..	
V. Miscellaneous receipts—								
(*i*) Receipts realized from Schemes.	1,36,290 3 1	2,900	500	6. Manual on 'Breeding of farm animals in India'.	439 0 0	(+)	61 0 0 (*a*)	(*a*) Inconsiderable.
(*ii*) Receipts on account of unspent balances of grants made by the Council.	65,798 11 2	500	..	7. Monograph on statistical methods in Animal Husbandry.	..		..	
(*iii*) Miscellaneous . . .	10,902 5 0	200		Inheritance of quantitative characteristics and laying qualities of eggs.	..		..	
				(*iii*) *Miscellaneous.*				
VI. Debts and remittances—								
(*i*) Loan and advances . .	2,106 12 0	34,000	1,40,200	1. Crop Cutting Experiments .	1,68,606 4 2	(—)	28,406 4 2 (*b*)	(*b*) Excess mainly due to payment of arrears of pay, etc., to the staff towards the close of the year.
(*ii*) Deposits and advances repayable.	20,026 11 0	7,280	12,300	2. Library	13,239 7 0	(—)	939 7 0 (*a*)	
(*iii*) Recoveries from the Research Staff on account of I. T., Provident Fund, etc.	34,420 3 9	15,710	48,500	3. Editorial staff for Indian Farming.	46,265 4 4	(+)	2,234 11 8 (*c*)	(*c*) Saving due to non-payment of arrears of pay, etc., to members of staff whose pay could not be refixed within the year.
Total Receipts and opening balance	38,41,255 10 8	..	5,300	4. Duplicating Section . .	5,302 15 0	(—)	2 15 0 (*a*)	
Investment and re-investment .	11,50,000 0 0	15,200	..	5. Appointment of a Fibre Expert	..		..	
Amount transferred to the Reserve Fund.	2,95,000 0 0	9,050	..	6. Camel breeding . . .	..		..	
		24,730	1,240	7. Improvement of livestock statistics.	1,290 13 0	(—)	50 13 0 (*a*)	
Grand Total .	52,86,255 10 8	1,60,000	92,000	8. Village Projects Delhi .	1,03,828 3 3	(—)	11,828 3 3 (*a*)	

RECEIPTS				PAYMENTS			
Head of Accounts	Receipts during the year	Grants: Original	Grants: Net	Head of Accounts	Expenditure during the year	Excess (—) or Savings (+) over net grant	Remarks
		Rs.	Rs.		Rs.	Rs.	
		..	100	9. Publications of abstracts	903 14 0	(—)803 14 0(*a*)	(*a*) Excess expenditure due to claims having been received late.
		..	170	10. Using aerial photography for crop estimation.	431 12 0	(—)261 12 0(*a*)	
		59,260	4,340	11. Collection of marine fishery statistics.	4,615 0 0	(—)275 0 0(*a*)	
				C.—GRANTS-IN-AID			
				(i) AGRICULTURE			
				(*a*) *Rice*			
		1,360	14,500	1. Rice breeding, Bombay	14,490 0 0	(+)10 0 0(*b*)	(*b*) Inconsiderable.
		1,090	..	2. Rice breeding, Hyderabad.	..	..	
		1,000	390	3. Rice breeding, Kashmir	387 8 0	(+)2 8 0(*b*)	
		1,430	1,300	4. Rice breeding, Travancore	1,297 3 2	(+)2 12 10(*b*)	
		1,500	6,000	5. Rice diseases, Madras	6,000 0 0	..	
		2,740	500	6. Rice breeding, Coorg.	500 0 0	..	
		14,220	..	7. Rice breeding, Punjab	..	..	
		4,710	..	8. Rice diseases, West Bengal.	..	..	
				(*b*) *Wheat and other cereals*			
		..	7,350	9. Wheat breeding, Central Provinces.	7 3 0	(—)117 3 0(*a*)	(*a*) Inconsiderable.
		..	19,350	10. Cereal rust, Agra	19,350 0 0	..	
		1,000	8,200	11. Weat rust research, Bombay	8,407 0 0	(—)117 0 0(*a*)	
			20,100	12. Wheat breeding, E. Punjab	20,100 0 0	..	
		10,000	12,150	13. Maize Breeding, I.A.R.I.	12,150 0 0	..	
		5,000	..	14. Maize Breeding, U.P.	5,900 0 0	(—)5,900 0 0(*a*)	(*b*) Demand for funds received very late.
		8,130	..	15. Maize Breeding, Bihar	..	..	
		16,200	..	16. Maize Breeding, W. Bengal	..	..	
		56,300	..	17. Co-ordinated rust control scheme.	..	..	
				(*c*) *Millets and Pulses*			
		1,260	8,780	18. Pulse breeding, Madras.	8,783 0 0	(—)3 0 0(*a*)	(*a*) Inconsiderable.
		8,000	390	19. Pulse Breeding, Bombay	14,616 8 0	(—)14,226 8 0(*b*)	(*b*) Demand for funds received very late.
		..	5,670	20. Pulse Breeding, U.P.	8,926 0 0	(—)3256 0 0(*b*)	

..	..	21. Pulse Breeding, Orissa	3,750	0	0	(—)	3,750	0			
3,300	3,900	22. Pulse Breeding, Assam	3,900	0	0		..				
770	..	23. Pulse Breeding, Mysore	1,700	0	0	(—)	1,700	0	0	(b)	
3,500	4,370	24. Pulse Breeding, Gwalior	4,541	0	0	(—)	171	0	0	(a)	
..	140	25. Pulse and millet Breeding, Baroda.	3,323	2	9	(—)	3,183	2	9	(b)	(b) Demand for funds received very late.
..	720	26. Small millets, Bombay	494	0	0	(+)	226	0	0	(c)	(c) Less amount demanded than was anticipated.
..	4,290	27. Small millets, U. P.	3,614	0	0	(+)	676	0	0	(c)	
..	890	28. Small millets, Mysore	890	0	0		..				
..	..	29. Small millets, C. P.	1	0	0	(—)	1	0	0	(a)	(a) Inconsiderable.
..	..	30. *Striga* attack on *Jowar* Bombay.	8,400	0	0	(—)	8,400	0	0	(b)	
..	..	31. Gram wilt diseases, E. Punjab	27,900	0	0	(—)	27,900	0	0	(b)	
7,430	..	32. Insect pests of stored cereal grains, Punjab.	5,560	0	0	(—)	5,560	0	0	(b)	
6,700	..	33. Pulses, W. Bengal	..				..				
..	..	34. Soya Beans, E. Punjab	18,900	0	0	(—)	18,900	0	0	(b)	
..	10	35. Physiology of pulses, W. Bengal.	12	2	6	(—)	2	2	6	(a)	
..	2,700	36. Cytogenetic research on pulses; Annamalai University.	2,690	0	0	(+)	10	0	0	(a)	
		(d) *Oilseeds.*									
..	790	37. Pests and diseases of Groundnuts, Madras.	541	0	0	(+)	249	0	0	(c)	
..	..	38. Multiplication of improved castor seed, Hyderabad.	248	7	0	(—)	248	7	0	(b)	
		(e) *Fruits.*									
16,000	14,000	39. Horticulture, Madras	14,001	0	0	(—)	1	0	0	(a)	
2,640	30,970	40. Horticulture, U. P.	30,967	14	6	(+)	2	1	6	(a)	
18,000	..	41. Horticulture, Bihar	..				..				
1,790	230	42. Horticulture, C. P.	226	0	0	(+)	4	0	0	(a)	
15,000	3,260	43. Horticulture, Assam	19,095	0	0	(—)	15,835	0	0	(b)	
230	10,980	44. Horticulture, Orissa	10,985	14	0	(—)	5	14	0	(a)	
14,000	5,180	45. Horticulture, Hyderabad	5,000	0	0	(+)	180	0	0	(a)	
..	14,000	46. Horticulture, Mysore	14,173	15	9	(—)	173	15	9	(a)	
..	3,770	47. Horticulture, Kashmir	3,763	0	0	(+)	7	0	0	(a)	
2,020	5,290	48. Orange cultivation, Coorg	5,288	3	0	(+)	1	13	0	(a)	
1,060	12,910	49. Mango Necrosis, Lucknow	13,070	10	0	(—)	160	10	0	(a)	
1,960	10,160	50. Cytogenetics of mango and banana, Poona.	10,000	0	0	(+)	160	0	0	(a)	
25,000	18,600	51. Banana research, Madras	18,600	0	0		..				
9,000	8,900	52. Banana research, Calcutta University.	8,992	12	11	(—)	92	12	11	(a)	(a) Inconsiderable.
900	220	53. Yield data from fruit orchards, C. P.	338	0	0	(—)	118	0	0		(b) Demand for funds received late.
3,150	2,600	54. Orange diseases, Madras	2,590	0	0	(+)	10	0	0	(a)	
2,800	1,220	55. Orange research, Madras	1,220	0	0		..				
1,550	..	56. Bud selection Societies, Bihar	..				..				
4,870	..	57. Banana research, Bombay	..				..				
9,000	..	58. Banana research, W. Bengal	..				..				

RECEIPT		PAYMENTS				
Head of Accounts	Receipts during the year	Grants		Head of Accounts	Expenditure during the year	Excess (—) or Savings (+) over net grants	Remarks
		Original	Net			
		Rs.	Rs.		Rs.	Rs.	
		—	—	59. Citrus manurial trials, E. Punjab.	4,800 0 0	(—)4,800 0 0	(a)
		2	—	60. Citrus physiology, Bihar	..	..	
		—	..	61. Insect pests of fruits, U. P.	7,400 0 0	(—)7,400 0 0	(a)
				(f) Vegetables			
		..	10,110	62. Cardamoms, Madras	10,111 0 0	(—)1 0 0	(b)
		2,840	300	63. Ginger, Madras	300 0 0	—	
		3,720	3,080	64. *Strigra* Sorghum, Madras	3,080 0 0	..	
		7,000	6,460	65. Chillies, Madras	6,460 0 0	..	
		12,810	1,620	66. Pepper, Madras	1,620 0 0	..	
		2,700	2,700	67. Treatment of crop, seeds, Delhi University.	2,700 0 0	..	
		5,490	..	68. Tuber crops, Bihar	..	..	
		3,420	..	69. Tuber crops, Mysore	..	..	
		4,440	..	70. Tuber crops, Punjab	2,000 0 0	(—)2,000 0 0	(a)
		4,180	1,260	71. Tuber crops, Orissa	1,260 0 0	..	
		5,700	..	72. Tuber crops, Bombay	..	..	
		500	..	73. Hybrid *cumbu*, Madras	..	..	
		5,000	..	74. Palmyra, Madras	..	..	
		790	..	75. Cloves, Travancore	..	..	
		780	20	76. Coriander diseases, Gwalior	15 0 0	(+)5 0 0	(c)
				(h) Soils and manures			
		12,350	..	77. Control of erosion, Visva Bharati	..	..	
		15,440	7,320	78. Trace elements in Indian Soils	7,320 0 0	..	
		..	640	79. Crop production by catalysis, Bangalore	..	..	
		10,000	6,120	80. Nitrogen fixation in soils, I. A. R. I.	6,000 0 0	..	
		..	4,470	81. Phosphatic manuring, I.A.R.I.	4,470 0	..	
		11,890	..	82. Soil erosion, Jaipur	..	..	
		6,750	..	83. Soil analysis, Andhra University	..	..	
				(i) Agronomy			
		..	31,480	84. Crop-weather co-ordination, Poona	31,48 0 0 0	..	
		1,500	..	85. Phenological observations, Bombay	..	..	

		(j) Physiology				
..	10,160	86. Plant Physiology, (Mr. Boshi Sen).	11,856 7 0	(—)1,6 796 (b)	(b)	Demands for funds received very late.
		(k) Entomology				
..	..	87. Schools of research . .	4,300 0 0	(—)4,300 0 0(b)		
14,290	..	88. Research on insecticides, Punjab	..	..		
4,760	3,060	89. Test with D. D. T., 666, I. A. R. I.	3,060 0 0	..		
..	1,980	90. Do., Madras . .	1,983 0 0	(—)3 0 0(a)	(a)	Inconsiderable.
..	..	91. Do., Bombay . .	..	..		
1,320	..	92. Do., U P. . .	..	..		
		(l) Mycology.				
..	21,870	93. Virus diseases Bombay .	21,870 0 0	..		
..	1,500	94. Schools of research . .	3,470 0 0	(—)1,970 0 0(b)		
3,000	3,330	95. Fungicidal sprays . .	207 8 0	(+)3,122 8 0(c)	(c)	Less money demanded than was anticipated.
		(m) General				
15,500	31,350	96. Introduction of new economic plants.	13,350 0 0	(+)18,000 0 0(c)	(c)	Less money demanded than was anticipated.
..	90	97. Indian Society of Agricultural Economics.	1,591 11 0	(—)1 11 0(a)	(a)	Inconsiderable.
		(ii) ANIMAL HUSBANDRY *(a) Cattle Breeding*				
..	280	1. Livestock investigation, East Punjab.	282 0 0	(—)2 0 0(a)		
8,000	..	2. Cattle Improvement and insurance, Patiala.	..	..		
2,730	..	3. Cattle improvement, Cochin .	..	..		
30,060	..	4. Causes of degeneration of Indian cattle	..	..		
4,630	1,790	5. Cattle improvement, Bombay . 6. Do. , U.P. . 7. Do. , Ajmer-Merwara. 8. Do. , Baroda . 9. Do. , Travancore 10. Do. , Madras .	1,790 3 9	(—)9 3 9(a)		
..	900	11. Animal Husbandry Bureau .	894 3 6	(+)5 13 0(a)		
		(b) Goat and Sheep Breeding				
..	3,470	12. Goat breeding, East Punjab .	3,580 0 0	(—)110 0 0(a)		
..	200	13. Do. ,Orissa .	3,979 12 6	(—)3,779 12 6(b)	(b)	Demand for funds was received very late.

RECEIPTS				PAYMENTS			
Head of Accounts	Receipts during the year	Grants		Head of Accounts	Expenditure during the year	Excess (—) or Savings (+) over net grants	Remarks
		Original	Net				
		Rs.	Rs.		Rs.	Rs.	
		10,780	..	14. Goat breeding, Cochin .	..	..	
		950	6,990	15. Sheep breeding, Madras .	7,452 14 9	(—)462 14 9(*a*)	
		..	33,580	16. Do. , Bombay .	33,583 4 0	(—)3 4 0(*a*)	
		..	860	17. Do. , E. Punjab .	9,230 7 0	(—)8,370 7 0(*b*)	
		..	5,100	18. Do. , Orissa .	5,110 0 0	(—)10 0 0(*a*)	
		16,000	10,640	19. Do. , Kashmir .	10,640 0 0	..	
				(*c*) *Animal Nutrition*			
		1,000	41,000	20. Animal nutrition, Assam .	41,000 0 0	..	
		..	1,960	21. Feeding of alkali treated cereal straw I. V. R. I.	1,960 0 0	..	
		1,000	18,000	22. Nutritive value of leafy fodders I. V. R. I.	18,000 0 0	..	
		..	6,990	23. Feeding of cattle on departmental farms, U. P.	6,987 0 0	(+)3 0 0(*a*)	(*a*) Inconsiderable.
		14,900	..	24. Animal nutrition, Madras .	..	..	
				(*d*) *Animal Pest and Diseases and Cure*			
		..	..	25. Veterinary investigation officer (Cattle) Madras	..	..	
		..	990	26. Do. Bombay .	985 0 0	(+)5 0 0(*a*)	
		..	..	27. Do. U. P. .	..	..	
		..	..	28. Do. Bihar .	..	..	
		..	..	29. Do. C. P. .	..	..	
		26,000	7,480	30. Do. Assam .	4,780 0 0	(+)2,700 0 0(*b*)	(*b*) Less amount demanded than anticipated.
		..	780	31. Do. Orissa .	778 0 0	(+)2 0 0(*a*)	
		..	..	32. Do. Hyderabad	..	..	
		..	..	33. Do. Ajmer-Merwara.	..	..	
		..	9,200	34. Do. Kashmir .	9,200 0 0	..	
		..	11,940	35. Do Baroda .	11,940 0 0	..	
		..	4,320	36. V. I. O. (Sheep and Goats) Bombay.	4,320 0 0	..	
		..	2,600	37. Do. E. Punjab .	2,600 0 0	..	
		..	..	38. Do. Orissa .	3,318 0 0	(—)3,318 0 0(*c*)	(*c*) Demand for funds was received late.

..	..	39.	Do.	Bihar	..			..				
22,060	3,510	40.	Do.	Baroda	3,510	0	0	..				
..	..	41.	Do.	Kashmir	..			..				
..	9,000	42.	Do.	Madras	9,000	0	0	..				
..	..	43.	Do.	Mysore	4,240	0	0	(—)4,240	0	0 (*c*)		
..	..	44.	Do.	W. Bengal	..			..				
5,000	26,890	45.	Tuberculosis and Johne's disease among animals, I.V.R.I.		26,890	0	0	..				
5,760	..	46.	V. I. O (Cattle) Mysore		..			..				
..	6,930	47.	Helminthic parasites, I.V.R.I.		16,930	0	0	(—) 10,000	0	0 (*a*)	(*a*)	Demand for funds received late.
3,190	10,190	48.	Vaccination against Foot and Mouth disease.		10,190	0	0	....				
..	21,350	49.	Damage caused by ticks and warble flies.		21,352	0	0	(—) 2	0	0 (*b*)	(*b*)	Inconsiderable.
..	1,600	50.	Indigenous drugs of India.		1,580	0	0	(+) 20	0	0 (*b*)		
..	4,600	51.	Helminthiasis of cattle, Madras.		4,600	0	0	....				
..	2,140	52.	Helminthiasis of cattle, U. P.		10,630	0	0	(—) 8,490	0	0 (*a*)		
..	..	53.	Diseases caused by anaeropees, I.V.R.I.		12,230	0	0	(—) 12,230	0	0 (*a*)		
6,000	110	54.	Tuberculosis testing, I. V. R. I.		109	0	0	(+) 1	0	0 (*b*)		
22,300	3,100	55.	Bearing of nutrition on helminthic infection, I. V. R. I.		3,100	0	0	....				
..	..	56.	Preparation of rinderpest vaccine, U. P.		1	0	0	(—) 1	0	0 (*a*)		
10,000	7,200	57.	Collection of information regarding indigenous drugs used in veterinary medicine.		7,200	0	0	....				
..	..	58.	Contagious abortion in cattle		3	0	0	(—) 3	0	0 (*a*)		
35,000	..	59.	Control of bovine pleuro-pneumonia, Assam.		....			....				
30,040	..	60.	Investigation of nastitis, I. V. R. I.		....			....				
3,730	..	61.	Investigation of nastitis, Bombay.		....			....				
3,730	..	62.	Investigation of nastitis, W. Bengal.		....			....				
3,450	..	63.	Investigation of nastitis, E. Punjab.		....			....				
2,520	..	64.	Investigation of nastitis, Mysore.		....			....				
			(e) Dairying									
560	..	65.	Development of *Ghee* industry, C. P.		....			....				
..	26,000	66.	Nutritive value of Vanaspati, I. V. R. I.		26,000		0	....				
3,700	3,530	67.	Quality improvement in milk and milk products.		3,530	6	6	(—) 0	6	6 (*a*)		
13,950	..	68.	Rapid determination of fats etc. of milk, U. P.		....			....				

RECEIPTS				PAYMENTS			
Head of Account	Receipts during the year	Grants		Heads of Accounts	Expenditure during the year	Excess (—) or Savings (+) over net grant	Remarks
		Original	Net				
		Rs.	Rs.		Rs.	Rs.	
		3,640	3,740	69. Purifying vegetable rennet.	3,740 0 0	....	
		..	1,760	70. Standardization methods for analysis of *ghee*, I. D. R. I.	1,847 2 0	(—) 87 2 0 (*a*)	(*a*) Inconsiderable.
		..	330	71. Lineolic acid content of *ghee*	333 6 0	(—) 3 6 0 (*a*)	
		12,000	1,030	72. Heat resistant flora in Indian milk	1,029 14 0	(+) 0 2 0 (*a*)	
		7,890	7,690	73. Refractive index of milk I. I. Sc., Bangalore.	7,690 0 0	....	
		18,630	..	74. Testing standard method for analysis of milk and milk products, I. D. R. I.	....	....	
		18,630	..	75. Testing standard method for analysis of milk and milk products, Bombay.	....	....	
		18,630	..	76 Testing standard method for analysis of milk and milk products, U. P.	....	....	
		18,630	..	77. Testing standard method for analysis of milk and milk products, Bihar.	....	....	
		11,970	..	78. Rapid determination of fats, etc. of milk, Punjab.	17,230 0 0	(—) 7,230 0 0 (*b*)	(*b*) Demand for funds received late.
		..	14,900	79. Composition of milk of cows, buffaloes, etc. I. D. R. I.	6,038 5 0	(—) 1,138 5 0 (*b*)	
		..	..	80. Bacteriological quality of market milk.	(—) 95 2 0	(+) 95 2 0 (*b*)	
		17,850	14,780	81. Standardization of the technique of manufacture to improve the market quality of *ghee*.	14,865 0 0	(—) 85 0 0 (*a*)	
		13,980	..	82. Rapid determination of fats, etc. of milk, W. Bengal.	....	....	
		6,080	..	83. Ghee analysis, I. I Sc., Bangalore.	....	....	
				(f) Wool			
		..	5,010	84. Wool analysis, Bombay University.	29,013 12 9	(—) 24,003 12 9 (*b*)	
		..	740	85. Wool analysis, Bihar.	735 0 0	(+) 5 0 0 (*a*)	
		..	5,480	86. Wool analysis, Baroda.	5,471 5 0	(+) 8 11 0 (*a*)	
		2,840	..	87. Wool analysis, Jaipur.	....	....	

		(g) Skins and Hides			
610	—	88. Defects caused by minor biological factors, I. . R. .	..	..	
		(h) Poultry			
—	7,400	89. Poultry breeding, I. V. R. I.	7,400 0 0	....	
	—	90. Diseases of poultry, Madras	3,780 0 0	(—) 3,780 0 0 (*a*)	(*a*) Demand for funds received late.
	3,130	91. Diseases of poultry, Bombay.	3,130 0 0	....	
	..	92. Diseases of poultry, W. Bengal.	....	....	
	..	93. Diseases of Poultry, U. P.	....	....	
	..	94. Diseases of poultry, E. Punjab.	....	....	
	..	95. Diseases of poultry, C. P.	6,490 0 0	(—) 6,490 0 0 (*a*)	
34,200	..	96. Diseases of poultry, Bihar.	....	....	
	4,400	97. Diseases of poultry, Assam.	4,390 0 0	10 0 0 (*b*)	(*b*) Inconsderable.
	2,600	98. Diseases of poultry, Orissa.	2,610 0 0	(—) 10 0 0 (*b*)	
	..	99. Diseases of poultry, Hyderabad.	1,360 0 0	(—) 1,360 0 0 (*a*)	
	2,140	100. Diseases of poultry, Mysore.	2,140 0 0	....	
	..	101. Diseases of poultry, Baroda.	....	....	
..	680	102. Deshi fowls, Baroda	621 10 0	58 6 0 (*b*)	
6,480	4,480	103. Poultry Research, C. P.	1,434 0 0	3,046 0 0 (*c*)	(*c*) Demand for funds not received.
4,500	2,300	104. Helminth parasites poultry, I. V. R. I.	2,310 0 0	(—) 10 0 0 (*b*)	
		(i) Fish			
11,440	25,000	105. Rural pisciculture, Madras	31,000 0 0	(—) 6,000 0 0 (*a*)	
5,820	1,430	106. Fish eggs and larvae, Madras	1,525 6 0	(—) 95 6 0 (*b*)	
10,800	9,000	107. Fishery research scholarships, Calcutta.	9,000 0 0	....	
2,700	..	108. Fishery research scholarships, Travancore.	....	....	
..	20	109. Investigation into bionomics of migratory fishes, W. Bengal	18 7 0	1 9 0 (*b*)	
3,700	1,500	110. Biology of marine prawns, Madras, University	1,500 0 0	....	
		(j) Apiculture			
..	..	111. Bee keeping, E. Punjab.	9,280 0 0	(—) 9,280 0 0 (*a*)	
		(k) Miscellaneous			
2,500	4,650	112. Using cows for work, I. D. R. I.	3,900 0 0	....	
		113. Using cows for work, Mysore.	750 0 0		
		114. Using cows for work, other centres.	....		

RECEIPT		PAYMENTS					
Head of Account	Receipts during the year	Grants		Heads of Accounts	Expenditure during the year	Excess (—) or Savings (+) over net grant	Remarks
		Original	Net				
		Rs.	Rs.		Rs.	Rs.	
				(iii) COMBINED AGRICULTURE AND ANIMAL HUSBANDRY SCHEMES.			
				(a) *Development*			
		13,370	..	1. Village project, Baroda.	....	....	
		1,750	..	2. Milk yielding trees, Bombay.	....	....	
				(b) *Fodder and Grazing*			
		300	450	3. Cultivation of Kudzu vine, Bombay.	450 0 0	....	
		6,600	2,800	4. Cultivation of Kudzu vine, I. A. R. I.	2,800 0 0	....	
		11,780	..	5. Silage making, PEPSU.	....	....	
		..	2,130	6. Statistical section.	2,141 11 0	(—) 11 11 0 (b)	(b) Inconsiderable.
		..	8,060	7. F. A. O. training centre in statistics.	7,615 13 0	(+) 444 3 0 (b)	
				(iv) MARKETING SCHEMES			
		..	40,250	1. Provincial marketing schemes	39,250 0 0	(+) 1,000 0 0 (b)	
				(v) MISCELLANEOUS SCHEMES			
		1,30,700	4,550	1. Crop cutting experiments.	55,800 0 0	(—) 50,750 0 0 (a)	(a) Demand for funds received late in March 1950.
		..	50,030	2. Pilot schemes of antimalarial operations in arecanut areas.	31,198 15 0	(+) 18,831 1 0 (c)	(c) Demand for grant not received in time.
				(D) CONTRIBUTIONS TO OTHER SCIENTIFIC INSTITUTIONS			
				(i) *Indian*			
		500	..	1. Indian bee keepers' Association.	....	....	

90	..	2. The Horticultural Society of India.	....		....	
2,000	1,400	3. The Indian Dairy Science Association.	1,874 15 0		(—) 474 15 0 (a)	
..	1,180	4. The Entomological Society of India.	1,175 0 0		(+) 5 0 0 (b)	
1,000	..	5. Indian Botanical Society	....		....	
		(ii) *Commonwealth and Imperial*				
	..	6. Commonwealth Agricultural Bureaux.				
	3,320	7. Imperial Institute of Mycology.	....		(+) 3,320 0 0 (d)	(d) Debits not received as anticipated.
52,600	2,800	8. Imperial Institute of Entomology.	....		+) 2,800 0 0 (d)	
		9. Farnham House Laboratory				
	..	10. Imperial Bureau of Dairy Science.				
	..	11. Fruit Preservation Research Station Compden.				
100	..	12. International Dairy Federation.	....		.....	
		E.—DEBTS AND REMITTANCES				
4,000	1,900	1. Loans and Advances.	2,250 0 0		(—) 350 0 0 (a)	(a) Inconsiderable.
1,000	11,690	2. Deposits and Advances repayable.	12,073 7 6		(—) 383 7 6 (a)	
15,000	11,690	3. Payment of incometax, Provident Fund. etc.	12,600 6 3		(—) 910 6 3 (a)	
		Total Expenditure .	17,53,312 8 6			
		Investments and reinvestments	31,00,000 0 0			
		Refund of unspent balance of the groundnut and linseed grant	12,420 0 0			
		Closing balance .	4,20,523 2 2			
		GRAND TOTAL .	52,83,255 10 8			

II. *Details of Advances.*

	Rs.
1. Permanent advance with the Secretary, I.C.A.R.	250
2. Permanent advance with the Rural Development Officer . . .	200
TOTAL . . .	450

III. *Particulars of securities etc.*

	Face Value			*Purchase Value*		
	Rs.	A.	P.	Rs.	A.	P.
1. 3% Stock, 1963-65	16,49,500	0	0	15,54,334	0	0
2. 3% 2nd Victory Loan, 1959-61 . . .	5,00,000	0	0	5,03,125	0	0
3. 3% Victory Loan, 1957 . . . . (*i*)	16,62,800	0	0	17,27,753	2	0
. . . . (*ii*)	1,93,400	0	0	1,99,983	14	10
4. 2½% Stock, 1962 . . . . (*i*)	4,00,000	0	0	4,00,000	0	0
. . . . (*ii*)	5,50,000	0	0	5,50,000	0	0
5. 5 Post Office 10 Year Defence Savings certificates.	5,000	0	0	5,000	0	0
6. 10 Post Office 15 Years cash certificates for Rs. 1,000 (Face value) each.	10,000	0	0	8,625	0	0
7. 16 Fixed Deposit Receipts of the Imperial Bank of India Nos. GO 3014 to 3029 for Rs. 50,000 each repayable at a week's notice.	8,00,000	0	0			
8. 3 Fixed Deposits Receipts of the Imperial Bank of India Nos. C 87986 to 87988 for Rs. 50,000 each repayable at a week's notice.	1,50,000	0	0			
9. 10 Short term Deposit Receipts of the Imperial Bank of India Nos. D 09914 to D 09923 for Rs. 50,000 each repayable at a week's notice.	5,00,000	0	0			
10. 18 one year Fixed Deposits Receipts of the Imperial Bank of India Nos. D 30843 to D 30860 for Rs. 50,000 each.	9,00,000	0	0			
11. One Fixed Deposit Receipt for the Imperial Bank of India No. D 30840 for Rs. 4,00,000.	4,00,000	0	0			
12. 12 Short terms Deposits of the Imperial Bank of India Nos. D 30897 to D 30908 for Rs. 50,000 each repayable at a week's notice.	6,00,000	0	0			
13. 14 Short Term Deposits of the Imperial Bank of India Nos. D 31190 to D 31200 and D 38201 to D 38203 for Rs. 50,000 each repayable at a week's notice.	7,00,000	0	0			
14. 10 Short term Deposits of the Imperial Bank of India Nos. D 38251 to 38260 for Rs. 50,000 each repayable at a week's notice.	5,00,000	0	0			
Total of securities . .	95,20,700	0	0			

IV. *Particulars of Closing Balances*

(1) Cash in hand with the Secretary, I.C.A.R. . . .	968	1	0
(2) In current account with the Imperial Bank of India, New Delhi and Post Office.	4,19,555	1	2*
	4,20,523	2	2

* Imperial Bank of India, New Delhi	3,25,840	2	8
Post Office	93,714	14	6
	4,19,555	1	2

S. R. MAINI, *Secretary,*
Indian Council of Agricultural Research.

The accounts have been examined and according to the best of my information and in consideration of the explanation given as a result of test audit of the accounts they are correct.

Sd/- R. L. KAPILA,
Assistant Accounts Officer, O.A.D. (C).

GIPD—M—130 IC of AR—12-3-51—1,200